URBAN TRANSIT RESEARCH AND DEVELOPMENT
INVENTORY OF PROJECTS AND VALUE ANALYSIS

Prepared For The Transportation Development Centre

By The Canadian Urban Transit Association

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DISCLAIMER

The contents of this report reflect the views of the contractor and not necessarily the official views or policies of the Transportation Development Centre.

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FOREWORD

This directory documents and describes current research and development projects relating to the urban transit industry. The purpose of the publication is to provide the transit industry with a detailed inventory and description of the R & D activities currently underway across Canada. More specifically the purpose of this publication is twofold:

(1) Promote the exchange and transfer of information, experience, and technology for the benefit of those agencies responsible for urban transit services and products.

(2) To familiarize researchers and those agencies funding research with the activities of their colleagues with a view to eliminating duplication of effort.

Persons wishing to obtain additional information on any project described herein is requested to contact the agency(s) which submitted the project description form. Persons wishing to have an R & D project described in any future project inventory are asked to contact the Canadian Urban Transit Association.

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ABBREVIATIONS

Throughout this report, abbreviations are used for common agency names. Please refer to the following abbreviations as required.

AISI	American Iron and Steel Institute
BILD	Board of Industrial Leadership and Development
CIGGT	Canadian Institute of Guided Ground Transport
CISC	Canadian Institute of Steel Construction
COTREM	Conseil des transports de la région de Montréal
CRIQ	Centre de recherche industrielle du Québec
CRT	Centre de Recherche sur les transports
CSICC	Canadian Steel Industry Construction Council
CTCRO	Commission de transport de la Communauté régionale de l'Outaouais
CTCUQ	Commission de transport de la Communauté urbaine de Québec
CTRSM	Commission de transport de la Rive sud de Montréal
CUTA	Canadian Urban Transit Association
EMR	Energy Mines and Resources Canada
FCAC	Formation de chercheurs et d'action concentrée
GO-ALRT	GO Advanced Light Rapid Transit Project
GVRD	Greater Vancouver Regional District
LTC/CTL	Laval Transit Commission/Commission de transport de la Ville de Laval
MTC	Ontario Ministry of Transportation and Communications
MUCTC/CTCUM	Montreal Urban Community Transit Commission/Commission de transport de la Communauté urbaine de Montréal
NRC	National Research Council
NSERC/CRSNG	National Science and Engineering Research Council of Canada/Conseil de recherche scientifique national en gênie
OUTA	Ontario Urban Transit Association
RTAC	Roads and Transportation Association of Canada
SSRC	Social Sciences Research Council
TDC/CDT	Transportation Development Centre/Centre de développement des transports
TRB	Transportation Research Board
TTC	Toronto Transit Commission
UBC	University of British Columbia
UMTA	Urban Mass Transportation Administration
UTDC	Urban Transportation Development Corporation

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17. Abstract

This report documents the research and development activities in the urban transit sector for the 1983-84 period. Descriptions of 276 research projects are provided including financial and administrative information, the purpose of the project, the research methodology used, project results/conclusions and further research work identified. The second half of the report includes an analysis of the value of each individual R & D project from the perspective of transit operators and federal and provincial government agencies.

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17. Résume

Ce rapport décrit les activités en recherche et développement dans le domaine du transport en commun (urbain) pour la période 1983-84. Deux cent soixante-seize projets sont décrits, chaque description inclut des renseignements financiers et administratifs, la raison d'être du projet, la méthodologie utilisée, les résultats/conclusions et le travail de recherche additionnel identifié. La deuxième partie du rapport comprend une analyse de la valeur de chaque projet du point de vue des transporteurs, et des gouvernements fédéral et provinciaux.

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EXECUTIVE SUMMARY

EXECUTIVE SUMMARY

This report documents the current research and development activities in the urban transit sector for the 1983-84 period. As well the perceived value of each project is documented based on a detailed questionnaire completed by various transit operators and government agencies.

Project Inventory

Over 400 agencies were asked to document their R & D activities including municipal, provincial and federal government agencies, transit operators, manufacturers and suppliers of transit equipment, universities, and private research organizations. Over 100 agencies supplied detailed descriptions of their R & D activities which number some 276 individual research projects.(1) The key results of this data collection effort are outlined below.

- The R & D activities in the urban transit sector are concentrated in three main areas, namely vehicle/system technology development, computer applications and development, and transportation planning and management. Other areas of research with the exception of service and methods demonstration are relatively inactive.

- The largest number of projects in single research area involves R & D on alternative energy vehicles and/or alternative fuels. This R & D is largely at the federal level reflecting the federal governments mandate to promote energy efficiency in the transportation sector as a whole.

- Although not a serious problem, there is some duplication of effort on national basis.

- Total urban transit R & D expenditures totalled \$17.3 million in 1983 representing \$77.6 million in R & D expenditures over the life of all projects. It is felt that these figures are underestimated by approximately 30%.

- In 1983, almost 50% of all R & D funds were spent on Computer Applications and Development followed by Vehicle/System Technology Development (38.8%), Service and Methods demonstration (6.6%), and Transportation Planning and Management (4.7%). All other areas of research in 1983 account for less than 4% of total R & D expenditures.

- Provincial agencies provided over 53% of the R & D funds expended in 1983. Federal agencies accounted for 21.4%, municipal agencies (including transit operators) 17.1%, private companies 7.0%, and other organizations 1.1%.

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(1) A very broad definition of R & D was used including basic research, applied research, development and demonstration projects.

o The largest single agency investment of R & D funds was by the Ontario Ministry of Transportation and Communications ($5.6 million in 1983) followed by Transport Canada ($1.2 million) and the Quebec Ministry of Transport ($1.1 million). Collectively, urban transit operators spent $2.8 on research and development in 1983 (48 projects), mainly in the areas of Transportation Planning and Management and Service and Methods Demonstration.

Value Analysis

The purpose of evaluating each individual project described in the project inventory was threefold.

(1) to provide researchers with constructive feedback on their R & D efforts.
(2) to provide funding agencies with some guidance concerning their current commitment of R & D funds.
(3) to promote the conduct of R & D which more effectively addresses the needs and priorities of the transit industry.

A total of eight evaluation criteria were used to evaluate each project in combination with a 5 point rating scale. In addition to evaluating each individual project, respondents were asked to evaluate the value of their own R & D efforts, identify the obstacles to more effective R & D, potential solutions to the identified obstacles, and outline how R & D projects were selected for funding. Finally, respondents were asked to indicate their degree of agreement/disagreement with a number of statements concerning the level of R & D, the value of R & D in broad subject areas, the value of R & D conducting by various types of organizations, the general benefits of research and methods for increasing the value of R & D in the urban transit industry as a whole.

The results, which are described below, include survey responses from 11 transit operators (of various sizes) and 5 government agencies (4 provincial, 1 federal).

o Of the 16 respondents, 12 indicated they were currently involved in conducting, funding, and/or administrating urban transit related R & D projects. In evaluating their own R & D efforts, only 1 of the 12 respondents involved in R & D indicated that their own R & D efforts were low in value. All the remaining respondents rated their own R & D efforts as moderate or high in value.

o Lack of R & D funds, lack of time and staff, lack of up-to-date information, and the lack of clear R & D policies were most frequently identified as obstacles to more effective R & D.

o Increased funding and a proper coordination mechanism for selecting, funding and implementing R & D projects were most frequently mentioned as solutions to the above obstacles.

- Despite the large amounts of money expended on R & D, the methods used to select R & D projects are largely qualitative rather than quantitative.

- Individual projects were rated highest on the benefit potential and utility criteria and lowest on urgency, originality/scope of interest and scientific potential.

- Many projects are clearly local in nature and have been conducted without consideration for regional or national interests.

- Government agencies were generally more optimistic when evaluating R & D projects in comparison to transit operators. (Government agency evaluations are generally 12-15% higher).

- Projects in the General Transportation Research, Training and Labour Relations and Computer Applications and Development subject categories ranked highest in value.

- Projects in the Policy and Program Development and Transportation Planning and Management subject categories ranked lowest in value.

- 6 of the top 10, and 11 of the top 27 ranked projects are in the Computer Applications and Development subject category. Of the 11 Computer Applications projects in the top 27, 8 are in the Comprehensive Vehicle Monitoring sub category.

- 5 CUTA initiated projects are in the 27 ranked projects.

- There is strong consensus that the level of urban transit R & D is unsatisfactory, that urban transit R & D funding should be increased to meet current industry needs and that current funding policies for the conduct of R & D are not generous enough.

- There is moderate consensus that the current R & D efforts of transit operators and manufacturers are valuable. However, the R & D efforts of provincial governments, the federal government and universities/private research organizations is in considerable doubt according to the respondents.

- There is a high degree of consensus that if transit operators and CUTA were more involved in project identification and selection, urban transit R & D would be more valuable. Provincial government involvement is also seen to be desirable, however, less Federal involvement in project identification and selection is seen to be desirable.

SECTION A

INVENTORY OF URBAN TRANSIT R&D PROJECTS

SECTION A - INVENTORY OF URBAN TRANSIT R & D PROJECTS

A.1 INTRODUCTION

The following section details the R & D projects completed and/or underway in 1983-1984 in the urban transit sector. Over 400 agencies were asked to document their R & D activities including municipal, provincial, and federal government agencies, transit operators, manufacturers and suppliers of transit equipment, universities, and private research organizations. Over 100 agencies supplied detailed descriptions of their R & D activities which number some 276 individual research projects. It should be noted that the R & D efforts of 2 major suppliers are not documented in this report. Flyer Industries Inc. did not respond to the request for R & D information and General Motors of Canada Limited, Diesel Division indicated that their R & D activities were proprietary in nature and, therefore, restricted to internal staff. Most transit operators serving communities with more than 250,000 population provided information for the project inventory although the information received is not necessarily representative of their total R & D activities.

A.2 DEFINITION OF RESEARCH AND DEVELOPMENT

In requesting R & D project descriptions, a very broad definition of R & D was used. This was done for two main reasons:

(1) Pure scientific research activities represent only a portion of the total R & D conducted for the urban transit industry. Many R & D projects are operational, policy, and/or planning related. While these projects are not R & D in the conventional sense, they are attempting to solve specific problems being experienced by the urban transit industry and, therefore, should be documented and the information exchanged for the benefit of the entire industry.

(2) It is operational type research which usually produces the most direct benefits to urban transit operators. As well, this type of research is consistently not documented in a formal manner, is poorly disseminated, and generally not well-known within the transit industry.

With the above in mind, the following definition of R & D was used:

Research and Development refers to creative and systematic investigation by means of experiment or analysis. Transit R & D includes operational, policy, technological, and systems research for regular transit and disabled transit operations including all forms of paratransit.

In order to qualify as transit R & D, the research activity must have significant application to the urban transit industry. In other words, the primary focus of the R & D should be the improved movement of persons within urban areas by public transportation systems and the improved efficiency of those systems.

More specifically, R & D can include four distinct but related types of activity:

a) Basic Research - Research aimed at increasing or advancing the stock of scientific and technical knowledge without a specific application in mind.

b) Applied Research - Research aimed at increasing or advancing the stock of scientific and technical knowledge with a specific application in mind. Includes work to determine possible uses for the results of basic research, or to determine methods of achieving some specific objective. Usually involves the consideration of available knowledge and its extension in order to solve particular problems.

c) Development - The use of the results of basic or applied research for the purpose of creating new or improved existing materials, devices, products, processes, techniques, methods, equipment, and systems.

d) Demonstration - The design, construction, testing, and evaluation of new or improved materials, devices, products, processes, techniques, methods, equipment, and systems.

Research and development projects described in this report cover the whole of the above innovation cycle or parts thereof. Related activities of R & D projects including the collection, analysis, and dissemination of the state-of-the-art technical data are also described in this report. Socio-economic analysis such as market, financial, and environmental studies have been included if they were related to the planning of R & D activities and projects or the assessment of the products of R & D activities.

When screening the R & D project descriptions only a limited number were rejected for not satisfying the above definitions. In most cases, the rejected projects were related to other transportation modes or the application of the research was clearly not targeted for the urban transit industry. Some projects were included in the project inventory even though the prime application was not the urban transit industry. The inclusion of these types of projects was limited to one subject area, namely alternative energy vehicles/alternative fuels. R & D on batteries, fuels, and various types of alternative fuel vehicles are included in this report for three main reasons:

(1) The level of activity in this area is significant.
(2) The potential implications for the urban transit industry are severe.
(3) In this subject area, it is extremely difficult to differentiate between projects of significance to all transportation modes and projects with significant applications only to urban transit.

Despite the broad definition used, it is evident that many small and medium sized transit systems have not reported operational/planning/policy type R & D projects which, from their perspective, did not qualify as R & D. While considerable success has been achieved in documenting the above types of projects, there is still room for improvement. It is hoped that transit systems will be more interested in supplying this type of information following examination of this report.

A.3 MAJOR R & D SUBJECT AREAS IN THE URBAN TRANSIT SECTOR

As shown in Table A.1 and Figure A.1, the R & D activities in the urban transit sector are concentrated in three main areas, namely vehicle/system technology development, computer applications and development, and transportation planning and management.

Other areas of research with the exception of service and methods demonstration are relatively inactive. The largest number of projects in a single research area involves R & D on alternative energy vehicles and/or alternative fuels. This R & D is largely at the federal level reflecting the federal governments mandate to promote energy efficiency in the transportation sector as a whole.

The financial statistics shown in Table A.1 indicate total urban transit R & D expenditures of $17.3 million in 1983 representing $77.6 million in R & D expenditures over the life of all projects. In 1983, almost 50% of R & D funds were spent on computer applications and development followed by vehicle/system technology development (38.8%), service and methods demonstrations (6.6%), and transportation planning and management (4.7%). All other areas of research in 1983 account for less than 4% of total R & D expenditures.

A.4 FUNDING SOURCES FOR URBAN TRANSIT R & D PROJECTS

As shown in Table A.2, provincial agencies provided over 53% of the R & D funds expended in 1983. Federal agencies accounted for 21.4%, municipal agencies (including transit operators) 17.1%, private companies 7.0%, and other organizations 1.1%. The largest single agency investment of R & D funds was by the Ontario Ministry of Transportation and Communications ($5.6 million in 1983) followed by Transport Canada ($1.2 million) and the Quebec Ministry of Transport ($1.1 million). Collectively, urban transit operators spent $2.8 on research and development in 1983 (48 projects), mainly in the areas of transportation planning and management and service and methods demonstration.

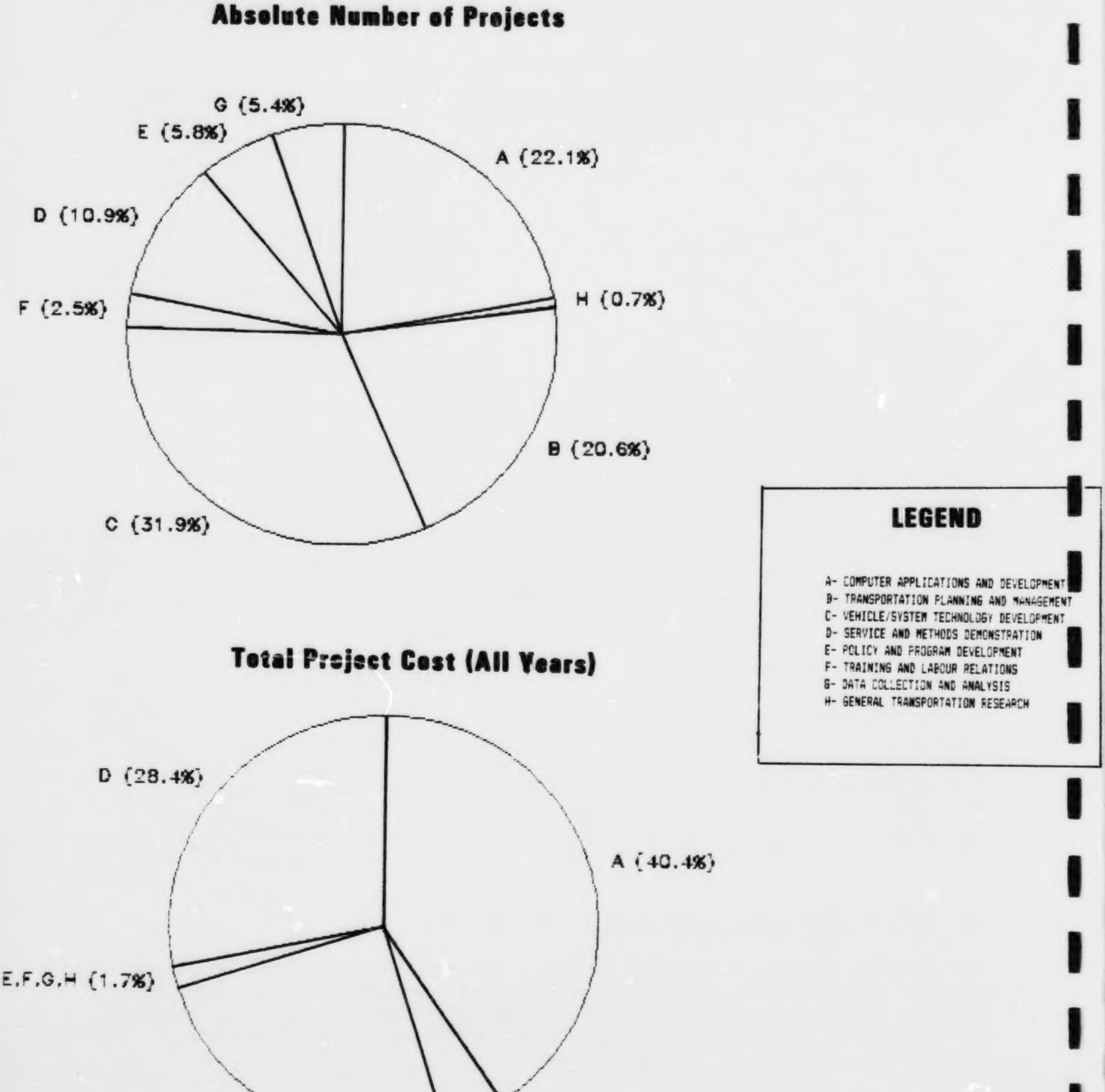
Although accurate, the total R & D expenditures for 1983 shown in Tables A.1 and A.2 ($17.3 million) underestimates actual R & D expenditure levels. This is due to the fact that no financial information was available for a total of 57 R & D projects. Secondly, the R & D efforts of General Motors of Canada and Flyer Industries are not included for proprietary reasons. Thirdly, there are undoubtedly a number of private companies, transit operators, and universities who either did not respond to the request for R & D information or were not contacted. As a result, it is estimated that total R & D expenditures in the urban transit sector in 1983 were closer to $25 million rather than $17.1 million as quoted.

A.5 LOCATING INDIVIDUAL R & D PROJECT DESCRIPTIONS

Two indexes, by subject area and by agency are provided in section A.5.1 and A.5.2 to assist in the location of specific R & D projects. Please note that all references in these indexes refer to project numbers and not page numbers. The individual projects are listed in order of subject category and are divided into 8 main areas in the following order:

FIGURE A.1

DISTRIBUTION OF PROJECTS BY SUBJECT AREA



Absolute Number of Projects

Total Project Cost (All Years)

TABLE A.1 - FINANCIAL BREAKDOWN OF R & D PROJECTS BY SUBJECT AREA

SUBJECT AREA	NUMBER OF PROJECTS	TOTAL PROJECT COST (ALL YEARS)	TOTAL PROJECT COST (1983 ONLY)
VEHICLE/SYSTEM TECHNOLOGY DEVELOPMENT (3)			
Bus/Trolley Coach Vehicles	3	$ 1,325,000	$ 1,000,000
Paratransit/Disabled Vehicles	3	2,535,000	1,250,000
Light Rail/Heavy Rail/Commuter Rail Vehicles	3	445,191	124,000
Vehicle Components/Engines	14	7,461,690	1,809,500
Alternative Energy Vehicles/Alternative Fuels	38	5,652,553	1,278,849
Electrical Distribution Systems	7	739,825	298,460
New System Development	8	839,053	407,673
New System Application	5	224,406	134,470
Safety and Product Qualification	1	30,000	30,000
Vehicle/System Market Research	3	88,800	30,240
Construction Techniques	3	688	440
SUB TOTAL	88	19,342,206(24.93%)	6,363,632 (36.76%)
SERVICE AND METHODS DEMONSTRATION			
Transportation Services for the Disabled and Elderly	2	315,000	65,000
Paratransit	3	41,400	26,500
Reserved Bus Lanes/Transit Priorities	9	884,200	121,233
Fare Collection/Fare Policies	10	1,702,600	177,700
Articulated Buses	5	19,069,000 (1)	755,000
Other Service and Methods Demonstration	1	3,576	576
SUB TOTAL	30	22,015,776(28.37%)	1,146,009(6.62%)

TABLE A.1 - FINANCIAL BREAKDOWN OF R & D PROJECTS BY SUBJECT AREA

SUBJECT AREA	NUMBER OF PROJECTS	TOTAL PROJECT COST (ALL YEARS)	TOTAL PROJECT COST (1983 ONLY)
COMPUTER APPLICATIONS AND DEVELOPMENT			
Maintenance and Materials Management Systems	2	-	-
Comprehensive Vehicle Monitoring Systems	10	$ 17,327,900	$ 6,595,000
Automatic Passenger Counting Systems	5	430,190	180,000
Transit Information Systems	7	1,479,880	158,000
Communication and Control Systems	9	3,624,799	380,464
Scheduling/Runcutting/Dispatching - Regular Transit	5	268,000	67,000
Scheduling/Runcutting/Dispatching - Disabled Transit	8	796,000	178,200
Fuel Management	2	10,000	2,000
Traffic Control Systems	4	1,705,000	342,000
General Computer Applications	4	5,023,000	350,000
Other Computer Applications	5	646,000	325,000
SUB TOTAL	61	31,311,169(40.35%)	8,577,664(49.54%)
TRANSPORTATION PLANNING AND MANAGEMENT			
Rapid Transit Studies	7	1,074,000	171,000
Impact of Transit	5	92,281	17,130
Terminals/Bus Shelters/Bus Bays/Park and Ride	9	266,000	54,000
Operational Planning Studies - Regular Transit	7	34,500	23,000
Operational Planning Studies - Disabled Transit	3	86,000	36,000
Land Use/Community Planning	2	12,000	-
Transportation Planning Models	9	1,507,700	295,000
Transit Planning Models	10	390,500	146,500
Energy Management	3	131,818	72,000
Risk Analysis	2	27,000	2,000
SUB TOTAL	57	3,621,799(4.67%)	816,630(4.71%)

TABLE A.1 - FINANCIAL BREAKDOWN OF R & D PROJECTS BY SUBJECT AREA

SUBJECT AREA	NUMBER OF PROJECTS	TOTAL PROJECT COST (ALL YEARS)	TOTAL PROJECT COST (1983 ONLY)
POLICY AND PROGRAM DEVELOPMENT			
Policy and Program Development - Regular Transit	10	$ 255,815	$ 134,000
Policy and Program Development - Disabled Transit	6	166,791	-
SUB TOTAL	16	422,606(0.54%)	134,000(0.77%)
TRAINING AND LABOUR RELATIONS			
Labour Relations	1	-	-
Absenteeism	1	-	-
Management Training	2	54,500	-
Operator Training	2	41,000	41,000
Other Training	1	38,025	-
SUB TOTAL	7	133,525(0.17%)	41,000(0.24%)
DATA COLLECTION AND ANALYSIS			
General Statistics/Performance Indicators	3	29,000	-
Origin/Destination and Travel-to-Work Data	7	215,000	181,500
Market Research	5	376,200	2,000
SUB TOTAL	15	620,200(0.80%)	183,500(1.06%)
GENERAL TRANSPORTATION RESEARCH	2	127,500(0.16%)	50,000(0.29%)
TOTAL	276	77,594,781 (2)	17,312,435 (2)

(1) Includes purchase costs for Ontario articulated bus demonstration project.
(2) No financial information for a total of 57 R & D projects.
(3) Does not include the R & D efforts of General Motors of Canada or Flyer Industries Ltd.

TABLE A.2 - FINANCIAL BREAKDOWN OF R & D PROJECTS BY AGENCY

NAME OF AGENCY	NUMBER OF FUNDED PROJECTS	TOTAL PROJECT COST (ALL YEARS)	TOTAL PROJECT COST (1983 ONLY)
Federal			
Transport Canada	45	$ 3,727,658	$ 1,242,706
National Energy Program	18	2,887,037	654,568
National Sciences and Engineering Research Council	14	822,031	156,226
National Research Council	5	1,823,900	467,260
Energy, Mines and Resources Canada	7	401,400	122,100
CN/VIA Rail	3	385,000	187,500
Other Federal Agencies	13	2,310,040	868,000
SUB TOTAL	105	12,357,066(15.92%)	3,698,360(21.36%)
Provincial			
Ontario Ministry of Transportation and Communications	36	39,173,056 (2)	5,616,433
Quebec Ministry of Transport	15	8,842,750	1,076,900
Alberta Transportation	22	642,561	182,899
BC Transit	8	551,225	283,460
Other Provincial Ministries	8	236,405	17,205
Other Provincial Agencies	19	3,822,480	2,062,140
SUB TOTAL	108	53,268,477(68.65%)	9,239,037(53.36%)
Municipal			
Transit Operators	48	5,815,602	2,792,131
Municipal Governments	38	2,350,648	176,701
SUB TOTAL	86	8,166,250(10.52%)	2,968,832(17.14%)

TABLE A.2 - FINANCIAL BREAKDOWN OF R & D PROJECTS BY AGENCY

NAME OF AGENCY	NUMBER OF FUNDED PROJECTS	TOTAL PROJECT COST (ALL YEARS)	TOTAL PROJECT COST (1983 ONLY)
Private Companies (4)			
Consultants	4	$ 106,000	$ 50,530
Manufacturers/Suppliers	25	3,117,998	1,167,556
SUB TOTAL	29	3,223,998(4.15%)	1,218,086(7.03%)
Other Organizations			
Private Associations	8	50,400	27,720
Universities	8	61,400	16,400
Miscellaneous	4	467,190	144,000
SUB TOTAL	20	578,990(0.75%)	188,120(1.09%)
TOTAL	348 (1)	77,594,781 (3)	17,312,435 (3)

FOOTNOTES

(1) Number of funded projects exceeds number of projects listed in the project inventory due to multiple funding sources for individual projects.
(2) Includes purchase costs for Ontario articulated bus demonstration project.
(3) No financial information for a total of 57 R & D projects.
(4) Does not include the R & D efforts of General Motors of Canada or Flyer Industries Ltd.

Vehicle/System Technology Development
Service and Methods Demonstration
Computer Applications and Development
Transportation Planning and Management
Policy and Program Development
Training and Labour Relations
Data Collection and Analysis
General Transportation Research

A.5.1 INDEX OF R & D PROJECTS BY AGENCY

The following index lists the R & D projects submitted by each individual agency. In some cases projects are listed more than once due to a number of agencies submitting project descriptions for the same project.

AGENCY	PROJECT NUMBER
A	
Alberta Transportation	91, 116, 208, 272
B	
BC Transit	163-164, 217
Beauchemin Beaton Lapointe Inc.	100, 102, 193
Bombardier Inc.	20, 21
C	
Cambridge Transit	12
Canada Mortgage and Housing Corporation	211
Canadian Bank Note Company	107
Canadian Resourcecon Ltd.	45-46
Canadian Urban Transit Association	108, 171-172, 198, 254, 260-261, 273
Catcom Systems Corp.	149
Centre de recherche sur les transports	153, 160-162, 214, 218
Centre de recherche industrielle du Québec	21
City of Calgary/Calgary Transit	13, 98, 110, 179, 186, 196, 199-200, 203-206, 209, 212, 220, 227, 230, 249, 257, 262, 271
City of Edmonton/Edmonton Transit	88, 106, 117, 127, 139-140, 187 201-202, 250-251, 259
Commission de transport de la Communauté régionale de l'Outaouais	124
Corporation intermunicipale du transport du Saguenay	165

AGENCY	PROJECT NUMBER
D	
Damas and Smith Ltd.	92, 188, 248
Department of Energy and Mines (Manitoba)	2
Department of Energy and Mines (Nova Scotia)	40, 123
Department of Roads and Traffic Metropolitan Toronto	94-95
Department of Urban Affairs (Manitoba)	2
M.M. Dillon Ltd.	215
Douglas Whitehead Consulting	276
Dynamic Sciences Ltd.	22-23, 130, 176-178
E	
Ecole polytechnique	228
F	
G	
Gandalf Data Ltd.	128, 158
Glenayre Electronics	150
GO Transit	104
H	
I	
Industrial Technology Centre (Manitoba)	49
Institut de recherche d'Hydro - Québec	35-37
J	
Joint Program in Transportation	207, 216, 219, 253, 269
K	
KVA Communications	135
Kitchener Transit	126, 137, 195
L	
Laval Transit Commission	97, 101, 114
M	
Metro Transit Commission - Halifax	123, 166
Montreal Urban Community Transit Commission	9, 14, 16, 66-68, 115, 119-120, 147, 174, 225, 240-241, 266-268

AGENCY	PROJECT NUMBER
N	
National Research Council	50-52, 56, 168
New York Air Brake/Vicom	10
Nova Scotia Research Foundation	152
O	
OC Transpo	15, 42, 44, 113, 129, 134, 154-156
Ontario Bus Industries Inc.	6
Ontario Ministry of Transportation and Communications	7, 18, 29, 41-42, 103-104, 113 121, 138, 145, 157, 173, 190, 237-239
Ontario Urban Transit Association	1, 191
P	
Pachena Scientific and Industrial Electronics	122
Pannell Kerr Forster Ltd.	62-65, 167
Paterson Planning and Research Ltd.	182, 237-238
Q	
Quebec Ministry of Industry Trade and Commerce	3
Quebec Ministry of Transport	8, 99, 114, 169, 192, 197, 244-245, 265
Queen's University	59-61, 79-81, 234
R	
Red Pine Instruments	15, 132-135
Roads and Transportation Association of Canada	162
S	
St. Catharines Transit Commission	118
St. John's Transportation Commission	109, 141
Saskatchewan Urban Affairs	210, 258
Saskatoon Transit	194
Science Council of British Columbia	38-39, 47-48
Sel Canada	144, 148, 151
Standard Change Makers	111
Stelco Inc.	86-87

AGENCY	PROJECT NUMBER
T	
Toronto Transit Commission	17, 95-96, 105, 112-113, 125, 136, 143, 146, 157, 180-181, 183-185, 226, 242, 274
Transit Windsor	11
Transport adapté du Québec Métro Inc.	159
Transport Canada	30, 43, 54, 69, 76, 162, 175, 233, 252, 255-256, 263-264, 270
Transportation Development Centre	4, 5, 19, 21, 24-28, 31-34, 57-58, 75, 77-78, 82-85, 90, 93, 131, 142, 170, 221, 232, 247, 275
Transurb	193
Transyt Canada	57, 70-74
U	
University of Alberta, Department of Civil Engineering	187, 189
University of B.C., Department of Civil Engineering	231, 236
University of B.C., Department of Mechanical Engineering	53
University of Calgary, Department of Civil Engineering	213
University of Waterloo, Transport Group	222-224, 229, 235
University of Western Ontario, Department of Economics	243, 246
V	
Vapor Canada Inc.	89
W	
Winnipeg Transit	55
X, Y, Z	

A.5.2 INDEX OF R & D PROJECTS BY SUBJECT AREA

The following index lists the R & D projects by subject area. Projects are listed only once even if a number of agencies submitted project descriptions for the same project.

SUBJECT AREA	PROJECT NUMBER
VEHICLE/SYSTEM TECHNOLOGY DEVELOPMENT	
Bus/Trolley Coach Vehicles	1 - 3
Paratransit/Disabled Vehicles	4 - 6
Light Rail/Heavy Rail/Commuter Rail Vehicles	7 - 9
Vehicle Components/Engines	10 - 23
Alternative Energy Vehicles/Alternative Fuels	24 - 61
Electrical Distribution Systems	62 - 68
New System Development	69 - 76
New System Application	77 - 81
Safety and Product Qualification	82
Vehicle/System Market Research	83 - 85
Construction Techniques	86 - 88
SERVICE AND METHODS DEMONSTRATION	
Transportation Services for the Disabled and Elderly	89 - 90
Paratransit	91 - 93
Reserved Bus Lanes/Transit Priorities	94 - 102
Fare Collection/Fare Policies	103 - 112
Articulated Buses	113 - 117
Other Service and Methods Demonstration	118
COMPUTER APPLICATIONS AND DEVELOPMENT	
Maintenance and Materials Management Systems	119 - 220
Comprehensive Vehicle Monitoring Systems	121 - 130
Automatic Passenger Counting Systems	131 - 135
Transit Information Systems	136 - 142
Communication and Control Systems	143 - 151
Scheduling/Runcutting/Dispatching - Regular Transit	152 - 156
Scheduling/Runcutting/Dispatching - Disabled Transit	157 - 164
Fuel Management	165 - 166
Traffic Control Systems	167 - 170
General Computer Applications	171 - 174
Other Computer Applications	175 - 179

SUBJECT AREA	PROJECT NUMBER
TRANSPORTATION PLANNING AND MANAGEMENT	
Rapid Transit Studies	180 - 185
Impact of Transit	186 - 191
Terminals/Bus Shelters/Bus Bays/Park and Ride	192 - 200
Operational Planning Studies - Regular Transit	201 - 207
Operational Planning Studies - Disabled Transit	208 - 210
Land Use/Community Planning	211 - 212
Transportation Planning Models	213 - 221
Transit Planning Models	222 - 231
Energy Management	232 - 234
Risk Analysis	235 - 236
POLICY AND PROGRAM DEVELOPMENT	
Policy and Program Development - Regular Transit	237 - 246
Policy and Program Development - Disabled Transit	247 - 252
TRAINING AND LABOUR RELATIONS	
Labour Relations	253
Absenteeism	254
Management Training	255 - 256
Operator Training	257 - 258
Other Training	259
DATA COLLECTION AND ANALYSIS	
General Statistics/Performance Indicators	260 - 262
Origin/Destination and Travel-to-Work Data	263 - 269
Market Research	270 - 274
GENERAL TRANSPORTATION RESEARCH	275 - 276

VEHICLE/SYSTEM TECHNOLOGY DEVELOPMENT

Project Number: 1
Subject: Bus/Trolley Coach Vehicles
Submitted by: Ontario Urban Transit Association

Project Title: Bus Specifications

Title of Report: Specifications Guidelines - Urban Transit Bus (1983)

Funding Source(s) and % Share: Ontario Ministry of Transportation and Communications (100%)

Consultants/Contractors Used: None

Total Project Cost: (all years) -

Total Project Cost: (1983 only) -

Start Date: 1981

Completion Date: April 1983

Project Manager: J. Hainsworth, Toronto Transit Commission (416) 534-9511

Dissemination of Results: Available from the Ontario Urban Transit Association or the Ontario Ministry of Transportation and Communications

Project Objective, Scope, Background, and Methodology:

Small transit systems in Ontario often tender for vehicles without a detailed bus specification outlining expected performance requirements, or other features which may be different from a bidder's standard design. Large transit systems have used detailed bus specifications for many years and commonly request specific features which have resulted in operating and maintenance costs savings. A standard specification for the manufacture and delivery of transit buses would allow (1) small transit systems to take advantage of larger systems experience with specific features, (2) would assist manufacturers in the design and construction of a standard high quality, uniformly price transit vehicle, and (3) assist the Ontario Ministry of Transportation and Communications when administering the transit subsidy program. A Bus Specifications Committee was established including representatives from MTC, selected transit operators, and vehicle manufacturers. The purpose of the Committee was to develop a set of standard specifications to describe a vehicle constructed and equipped so as to provide optimum performance in regard to safety, environmental features, comfort, maintenance, roadability, reliability, attractiveness, and publi acceptance.

Project Results/Conclusions/Preliminary Findings:

Bus Specification Guidelines prepared and distributed to OUTA members.

Further Research Work Identified:

Further revisions to the specifications will be considered by the Bus Specifications Committee as required.

Project Number: 2
Subject: Bus/Trolley Coach Vehicles
Submitted by: Department of Energy and Mines (Manitoba)
Department of Urban Affairs (Manitoba)

Project Title: Urban Bus Industrial Development Project

Title of Report: Not Known

Funding Source(s) and % Share: Governments of Canada and Manitoba (% share currently being negotiated)

Consultants/Contractors Used: J.F. Hickling Management Consultants

Total Project Cost: (all years) n/a

Total Project Cost: (1983 only) n/a

Start Date: 1984

Completion Date: 1989

Project Manager: G. Spiece, Department of Regional Industrial Expansion (Winnipeg)

Dissemination of Results:

Project Objective, Scope, Background, and Methodology:

According to a memorandum of understanding signed by the two governments December 8, 1983, the objective is to establish Winnipeg as a centre of expertise for the technological development and manufacturing of advanced urban buses and other related industrial products. The plan would focus on three main areas: R & D, prototype development, and demonstration. An assessment project has been initiated to define a variety of technological and institutional developments that could further the above agreement. The study includes (1) an examination of technological options that would lead to a development program for advanced design buses and related industrial products and (2) the development program requirements including existing and potential participants and organizational mechanisms.

Project Results/Conclusions/Preliminary Findings:

Details to be finalized by end of March 1984.

Further Research Work Identified:

Not yet determined.

Project Number: 3
Subject: Bus/Trolley Coach Vehicles
Submitted by: Quebec Ministry of Industry, Commerce and Tourism

Project Title: Development of a 102" wide inter-city bus

Title of Report: None

Funding Source(s) and % Share: Société du développement industriel - Québec, (75%)

Consultants/Contractors Used: Prévost Car

Total Project Cost: (all years) $1,325,000

Total Project Cost: (1983 only) $1,000,000

Start Date: April 1983

Completion Date: June 1984

Project Manager: Denis Bertrand, Louis Pommerleau - Prévost Car

Dissemination of Results:

Project Objective, Scope, Background, and Methodology: To assist Prévost in developing a 102" wide bus thus making them the only North American bus manufacturer of such a product. This development is possible as American states have amended their legislation which limited bus widths to 96". Prévost has completed the conceptual design, research and development of the product. A prototype has been tested.

Project Results/Conclusions/Preliminary Findings: Development and tests are completed. Production has begun at the Ste. Claire plant. Marketing in the U.S. looks promising.

Further Research Work Identified: Information not available.

Numéro du Projet 3
Sujet: Bus/Trolley Coach Vehicles
Soumis par: Ministry of Industry, Commerce and Tourism

- -

Titre du projet:	Développement d'un autocar d'une largeur de 102"		
Titre du rapport:	Non pertinent		
Source de financement et pourcentage des coûts défrayés par chaque organisme:	Société des développements industriel (75%)		
Consultants/Sous-traitants:	Prévost Car		
Coût total: (toutes les années)	$1,325,000	Coût total du projet: (1983 seulement)	$1,000,000
Le projet débute le:	Avril 1983	Fin du projet:	Juin 1984
Directeur du projet:	Denis Bertrand, Louis Pommerleau (Prévost Car)		
Dissémination des résultats:	Non pertinent		

- -

But, étendue, antécédents et méthodologie du projet:

L'entreprise manufacturière Prévost Car a développé un autocar d'une largeur de 102" ce qui lui permet d'être le seul fabricant nord-américain d'un tel produit. Ce développement a été possible suite aux modifications des lois américaines qui jusqu'alors n'autorisaient que des autocars d'une largeurs de 96". Prévost Car a fait la conception, la recherche et le développement du produit. Elle a réalisé un prototype qu'elle a testé.

- -

Résultats/Conclusions/Résultats préliminaires:

Le développement et les essais sont terminés et la production a débuté à l'usine de Ste-Claire. La mise en marché aux États-Unis semble porter fruit.

- -

Travail de recherche additionnel identifié:

Information non disponible.

Project Number:	4
Subject:	Paratransit/Disabled Vehicles
Submitted by:	Transportation Development Centre

Project Title: Transit Vehicle for the Disabled

Title of Report: Transit Vehicle for the Disabled - Phase I Definition of Requirements

Funding Source(s) and % Share: DeLCan provided services for Phase I as a contribution to the year of the Disabled

Consultants/Contractors Used: DeLCan

Total Project Cost: (all years) $10,000 Total Project Cost: (1983 only) -

Start Date: May 1981 Completion Date: February 1982

Project Manager: L. Suen, (514) 283-4100

Dissemination of Results: Limited number of copies available from the Transportation Development Centre and the Canadian Urban Transit Association.

Project Objective, Scope, Background, and Methodology:

Transportation services for disabled Canadians are being provided by many urban transit operators, but due to the lack of a vehicle specifically designed for this purpose, modified minibuses and vans designed for other uses have found wide applications. Resulting areas of deficiency include reliability, comfort, safety, and serviceability. The purpose of the project is to improve access and safety of transit services for the disabled through the development of functional specifications which will serve as a guideline for tendering and for manufacturers of transit vehicles for the disabled. The study focuses primarily on vehicles used in parallel transit services. Phase I of the three phase study includes an inventory and review of vehicles in use or under development in the U.S., Canada, and Europe, an overview of existing standards, a survey of users and operators requirements, an evaluation of the inventoried vehicles, the identification of requirements for a new "ideal" vehicle; and the desirability of proceeding with the second phase of the study - Market Analysis.

Project Results/Conclusions/Preliminary Findings:

None of the vehicles currently in use or under development are completely satisfactory with respect to the users and operators of parallel services. There is a clear need for a "new ideal" vehicle which more closely meets the requirements of both interest groups. Vehicle attributes for such a vehicle have been identified, however, the cost of purchasing such a vehicle (if developed) would likely be significantly higher than vehicles presently used in Canada.

Further Research Work Identified:

The commercial feasibility for the development of the ideal vehicle and the potential should be identified.

Project Number: 5
Subject: Paratransit/Disabled Vehicles
Submitted by: Transportation Development Centre

Project Title: Transit Vehicle for the Disabled

Title of Report: Transit Vehicle for the Disabled - Phase III Specification Guidelines

Funding Source(s) and % Share: Transportation Development Centre (100%)

Consultants/Contractors Used: DeLCan

Total Project Cost: (all years) $15,000 Total Project Cost: (1983 only) $4,000

Start Date: October 1982 Completion Date: February 1983

Project Manager: L. Suen, (514) 283-4100

Dissemination of Results: Limited number of copies available from the Transportation Development Centre and the Canadian Urban Transit Association. Summary report of all phases also available.

Project Objective, Scope, Background, and Methodology:

Phase III involved the development of functional specifications which will serve as a guide for the tendering and manufacturing of disabled transit vehicles. This is as a result of Phases I and II and in response to the fact that many municipalities are purchasing specialized vehicles for transportation of the mobility handicapped. Due to the infrequency of these purchases and the unfamiliarity with those specialized vehicle aspects that suit the vehicle for its intended role, the purchaser is commonly unsure of what items should be included in the tender package. Similarly, with increased demand for specialized vehicles there is an increase in the number of suppliers, some of whom may not be fully aware of the optimum or even acceptable specifications for vehicle components or performance. Phase III - Specification Guidelines is intended to provide the purchaser with specify vehicle design and/or performance criteria for efficient vehicle utilization, and the vehicle manufacturer with design or specify vehicle components such that they are responsive to the purchaser's requirements.

Project Results/Conclusions/Preliminary Findings:

To assist purchasers and manufacturers, current provincial and federal standards are outlined. Vehicle specifications in the following areas were developed; vehicle capacity selection, passenger access and egress, vehicle interior, vehicle performance and cost, vehicle procurement considerations and typical specifications.

Further Research Work Identified:

None

Project Number: 6
Subject: Paratransit/Disabled Vehicles
Submitted by: Ontario Bus Industries Inc.

Project Title: Development of a Small Heavy Duty Accessible Transit Bus

Title of Report: None

Funding Source(s) and % Share: Ontario Bus Industries Inc., (40%)
Department of Industry of Trade & Commerce, (60%)

Consultants/Contractors Used: G. Gidman Design Associates, DSMA Atcon Ltd., Carr Sawyer Inc.

Total Project Cost: (all years) $2,500,000
Total Project Cost: (1983 only) $1,250,000

Start Date: January 1982
Completion Date: March 1985

Project Manager: Michael G. Marlatt

Dissemination of Results: Marketing Material

Project Objective, Scope, Background, and Methodology:

To design, develop, and test a small heavy duty accessible transit vehicle from initial concept to production phase. Based on market research indicating most small buses available on the market were almost totally unacceptable from the point of reliability, life cycle cost, comfort, ride, climate control, accessibility and in general, features required for transportation of passengers by large or small operators. Ontario Bus Industries Inc. in 1983 was in advanced stages of development of a low floor, heavy duty, front wheel drive small bus. Construction is stainless steel, components all heavy duty with access by means of very short power ramp.

Project Results/Conclusions/Preliminary Findings:

One prototype completed eleven (11) months of testing as of April 1984. Nine more prototype in advanced stages of completion as of April 1984. Field unit giving excellent performance representing many major advancements in small bus technology, i.e. low floor, front wheel drive, stainless construction, independent rear suspension, hydraulic accessory drives, air conditioning system, and overall configuration. See Appendix I for a detailed description of the technical specifications of the above vehicle.

Further Research Work Identified:

Research in this area is essentially open ended as many new concepts will be developed and tested.

7

Project Number: 7
Subject: Light Rail/Heavy Rail/Commuter Rail Vehicles
Submitted by: Ontario Ministry of Transportation and Communications

Project Title: Articulated Light Rail Vehicle (ALRV)

Title of Report: Articulated Light Rail Vehicle - Revenue Service Report

Funding Source(s) and % Share: Ontario Ministry of Transportation and Communications (100%)

Participants: Urban Transportation Development Corporation, Toronto Transit Commission

Total Project Cost: (all years) $320,191 | Total Project Cost: (1983 only) $124,000

Start Date: June 1982 | Completion Date: August 1984

Project Manager: Wes Meyer, UTDC; D. Juneja, Transit Office, MTC; D. Cowan, TTC; T. Apparrao, Vehicl Systems, MTC

Dissemination of Results: n/a

Project Objective, Scope, Background, and Methodology:

The objective is to test and prove the ALRV in revenue service and to provide TTC an opportunity to evaluate the performance of this vehicle on the system. The physical and operational capabilities of this vehicle will be assessed and documented by UTDC and TTC. ALRV is a six axle articulated street car developed by UTDC. This vehicl is 23.06 metres (75.7 ft.) long and carries over 200 passengers.

Project Results/Conclusions/Preliminary Findings:

UTDC and TTC have produced draft reports. These reports are under review. Final report is expected before the end of 1984.

Further Research Work Identified:

None.

Project Number: 8
Subject: Light Rail/Heavy Rail/Commuter Rail Vehicles
Submitted by: Quebec Ministry of Transport

Project Title: Modernization of Commuter Trains

Title of Report: None

Funding Source(s) and % Share: Quebec Ministry of Transport (100%)

Consultants/Contractors Used: None

Total Project Cost: (all years) -
Total Project Cost: (1983 only) -

Start Date: -
Completion Date: -

Project Manager: André Bolduc, (418) 643-1675

Dissemination of Results:

Project Objective, Scope, Background, and Methodology:

Research has been made concerning the design of the furniture (lamps, seats, fences, signs). The rail context, with its calibre, its lightning requirements, has required an adaptation of products and the using of special materials.

Project Results/Conclusions/Preliminary Findings:

None

Further Research Work Identified:

None

Numéro du Projet	8
Sujet:	Light Rail/Heavy Rail/Commuter Rail
Soumis par:	Ministère des transports du Québec

- -

Titre du projet:	Modernisation des trains de banlieue		
Titre du rapport:	Aucune		
Source de financement et pourcentage des coûts défrayés par chaque organisme:	Ministère des transports du Québec, (100%)		
Consultants/Sous-traitants:	-		
Coût total: (toutes les années)	-	Coût total du projet: (1983 seulement)	-
Le projet débute le:	-	Fin du projet:	-
Directeur du projet:	André Bolduc, (418) 643-1675		
Dissémination des résultats:	-		

- -

But, étendue, antécédents et méthodologie du projet:

Dans le cadre de la modernisation des trains de banlieue, une recherche a dû être effectuée sur le design du mobilier (lampe, bancs, clôtures, panneaux de signalisation...). Le contexte ferroviaire avec son gabarit, ses exigences d'éclairage a nécessité une adaptation des produits et l'utilisation de matériaux spéciaux.

- -

Résultats/Conclusions/Résultats préliminaires:

- -

Travail de recherche additionnel identifié:

Project Number: 9
Subject: Light Rail/Heavy Rail/Commuter Rail Vehicles
Submitted by: Montreal Urban Transit Commission

Project Title: Research on Carrying and Guiding Tires Verifying Devices

Title of Report: Electronic Test Zones

Funding Source(s) and % Share: MUCTC (100%)

Consultants/Contractors Used: B.T.M. International

Total Project Cost: (all years) $125,000
Total Project Cost: (1983 only) -

Start Date: January 1984
Completion Date: January 1986

Project Manager: Jean-Denis Pelletier (514) 877-6077

Dissemination of Results:

Project Objective, Scope, Background, and Methodology:

The purpose of this project is to build a set of electronic devices to verify carrying and guiding tires that are below normal pressure as well as to verify the functionning of the negative current return shoes and of the lower template of the rails located at the exit of repair stations.

Project Results/Conclusions/Preliminary Findings:

No results available.

Further Research Work Identified:

Numéro du Projet 9
Sujet: Light Rail/Heavy Rail/Commuter Rail Vehicles
Soumis par: Commission de transport de la Communauté urbaine de Montréal

Titre du projet: Recherche sur dispositifs de vérification des pneus porteurs et de guidage

Titre du rapport: Zones-test électroniques

Source de financement et pourcentage des coûts défrayés par chaque organisme: CTCUM (100%)

Consultants/Sous-traitants: B.T.M. International

Coût total: (toutes les années) $125,000
Coût total du projet: (1983 seulement) -

Le projet débute le: Janvier 1984
Fin du projet: Janvier 1986

Directeur du projet: Jean-Denis Pelletier (514) 877-6077

Dissémination des résultats:

But, étendue, antécédents et méthodologie du projet:

Ce projet consiste à fabriquer un ensemble de dispositifs électroniques pour vérifier les pneus porteurs et de guidage en sous pression. Vérification aussi du bon fonctionnement des frotteurs négatifs et du gabarit inférieur des rames à la sortie des ateliers de réparation et des fosses de visite.

Résultats/Conclusions/Résultats préliminaires:

Résultats non disponibles.

Travail de recherche additionnel identifié:

Project Number: 10
Subject: Vehicle Components/Engines
Submitted by: New York Air Brake/Vicom

Project Title: Shock Absorbers & Yaw Dampers for Rail Vehicles

Title of Report: Shock Absorbers & Yaw Dampers

Funding Source(s) and % Share: New York Air Brake/Vicom (100%)

Consultants/Contractors Used: None

Total Project Cost: (all years) $75,000 Total Project Cost: (1983 only) $25,000

Start Date: September 1983 Completion Date: December 1984

Project Manager: J.J. MacKay, NYAB Vicom (613) 389-4660

Dissemination of Results: Performance specifications, only, will be released to potential users.

Project Objective, Scope, Background, and Methodology:

To produce a complete line of railroad and transit shock absorbers and yaw dampers. Initial development has been focused on a specific problem. Prototypes developed from a computer model are being lab tested. Car tests will commence in April 1984.

Project Results/Conclusions/Preliminary Findings:

None

Further Research Work Identified:

None

Project Number:	11
Subject:	Vehicle Components/Engines
Submitted by:	Transit Windsor

Project Title:	Detroit Diesel Allison 8.2 litre diesel engine		
Title of Report:	Experimental Engine & Transmission Project		
Funding Source(s) and % Share:	Detroit Diesel Allison/General Motors Diesel Division (75%) Transit Windsor (25%)		
Consultants/Contractors Used:	Jerry Trotter, Detroit Diesel Allison, Indianapolis/ General Motors facilities, London, Ontario		
Total Project Cost: (all years)	-	Total Project Cost: (1983 only)	-
Start Date:	February 16, 1981	Completion Date:	Ongoing
Project Manager:	Yow Kit Chan, General Motors, (519) 452-5252		
Dissemination of Results:	General Motors Canada, Reports sent to MTC		

Project Objective, Scope, Background, and Methodology:

Primary objective was to reduce life cycle and fuel usage costs. Transit Windsor was contacted to enter into an agreement with G.M. to test a power module consisting of 8.2 litre diesel engine and MT643 Transmission equipped with hydraulic retarder. This power module was retrofitted to a G.M. Model 5307N, 40' new look coach, eliminating the V drive applying a "T" drive system.

Project Results/Conclusions/Preliminary Findings:

Results are incomplete. Preliminary findings do show an increase of kilometres/litre of fuel. Total life cycle costs have not yet been addressed.

Further Research Work Identified:

Transit Windsor will continue to use and closely monitor the results of this application. Total engine life needs to be determined before costs can be evaluated.

Project Number: 12
Subject: Vehicle Components
Submitted by: Cambridge Transit

Project Title:	Repowering 30 Foot G.M. Coach		
Title of Report:	Conversion of DH478 to 8.2 Litre		
Funding Source(s) and % Share:	Cambridge Transit, (100%)		
Consultants/Contractors Used:	Harper Detroit Diesel/Cambridge Transit		
Total Project Cost: (all years)	$10,500	Total Project Cost: (1983 only)	$10,500
Start Date:	February 22, 1983	Completion Date:	March 31, 1984
Project Manager:	Jim Gladstone, Foreman of Transit Maintenance, (519) 623-1340		
Dissemination of Results:	All CUTA members		

Project Objective, Scope, Background, and Methodology:

Cambridge Transit presently has six (6) thirty (30) foot coaches in operation. There are all General Motors Coaches used for feeder routes in specific areas of the City. The coaches are now eleven (11) years old, and although they are structurally sound, the power train has become difficult to maintain due to breakdowns and the difficulty in procuring parts. Since the decision has been made to keep these vehicles in service for another five (5) to eight (8) years, it was decided to repower them with 8.2 litre Detroit Diesel engines. At the present time we have one (1) coach in operation with the 8.2 litre engine. This coach has been in service since February 22, 1983 with very few problems. All retrofitting for this repower was done in house. A naturally aspirated 8.2 litre engine was successfully installed to replace a DH 478 toro-flow engine. Before and after comparisons of fuel consumption and engine maintenance were made.

Project Results/Conclusions/Preliminary Findings:

Fuel mileage was monitored daily and monthly by a Vertek Fuel Computor System. Average fuel savings between buses show a 1.5 L/100 Km fuel savings over a period of fourteen (14) months by using the 8.2 litre engine. Although engine maintenance was relatively minor for both engines during the comparison period, Cambridge Transit is pleased with the present performance and driver acceptance of the 8.2 Litre engine. By combining the factors of better fuel mileage and greater parts availability of the 8.2 Litre engine, will result in both a savings and a more efficient transit fleet for Cambridge Transit.

Further Research Work Identified:

Plans have been made to replace three (3) more power trains in 1984 and the remaining two (2) in 1985 with 8.2 litre engines. Updating of the present AT 540 transmissions to AT 545 transmissions will be part of future repowers.

Project Number: 13
Subject: Vehicle Components/Engines
Submitted by: City of Calgary/Calgary Transit

Project Title: Electronic Destination Sign

Title of Report: Evaluation of Electronic Destination Signs

Funding Source(s) and % Share: Province of Alberta, (67%), City of Calgary, (33%)

Consultants/Contractors Used: None

Total Project Cost: (all years) $28,000 Total Project Cost: (1983 only) -

Start Date: 1979 Completion Date: 1983

Project Manager: D. Bolger, City of Calgary, Transportation Department, (403) 268-1631

Dissemination of Results: Report available from the City of Calgary, Transportation Department, P.O. Box 2100, Calgary, Alberta, T2P 2M5

Project Objective, Scope, Background, and Methodology:

The purpose is to evaluate the use of electronic destination signs on Calgary Transit buses. In 1977 the first electronic destination sign was installed on a Calgary Transit bus, one year of operation led to the purchase of five additional units and initiation of full scale testing. Units were evaluated relative to capital costs, installation and serviceability, maintenance, flexibility and limitations, visibility and readability, transit driver performance, and transit patron preference. Where applicable direct comparisons were made between test units and mylar mechanical roller signs currently in use.

Project Results/Conclusions/Preliminary Findings:

Although the initial cost of electronic signs is 3.5 times that of the standard roller sign, the capacity, flexibility, durability, low maintenance and updating costs, ease of operation make the use of electronic signs more desirable. Visibility is perceived by transit patrons to be equal or superior to roller signs. Report recommends Calgary Transit use electronic signs on all new and existing buses.

Further Research Work Identified:

Nil

Project Number: 14
Subject: Vehicle Component
Submitted by: Montreal Urban Transit Commission

Project Title: Electronic Destination Signs

Title of Report: -

Funding Source(s) and % Share: MUCTC (100%)

Consultants/Contractors Used: None

Total Project Cost: (all years) -

Total Project Cost: (1983 only) -

Start Date: -

Completion Date: -

Project Manager: Jean-Denis Pelletier (514) 877-6077

Dissemination of Results:

Project Objective, Scope, Background, and Methodology:

MUCTC currently has three types of listings on bus destination signs. By using electronic signs, only one type of listing would be used. The major advantage is the minimum delay in changing text on the units. The text currently has to be changed every three or four years on approximately 2,500 units. At a cost of $200.00 each, (October 82), total cost is $500,000. Are currently conducting tests with the Transign Company. Results are satisfactory, however, no comments have been received by the Transportation Department nor the users. Are also considering tests with other companies.

Project Results/Conclusions/Preliminary Findings:

No results available.

Further Research Work Identified:

Numéro du Projet	14
Sujet:	Vehicle Components
Soumis par:	Commission de transport de la Communauté urbaine de Montréal

- -

Titre du projet:	Girouette électronique		
Titre du rapport:	-		
Source de financement et pourcentage des coûts défrayés par chaque organisme:	CTCUM (100%)		
Consultants/Sous-traitants:	Aucun		
Coût total: (toutes les années)	-	Coût total du projet: (1983 seulement)	-
Le projet débute le:	-	Fin du projet:	-
Directeur du projet:	Pierre De Villers (514) 877-6079		
Dissémination des résultats:			

- -

But, étendue, antécédents et méthodologie du projet:

Nous utilisons actuellement trois types de "listing" sur nos rideaux de girouette. En utilisant des girouettes électroniques, un seul type serait utilisé. Le principal avantage serait la rapidité à changer les inscriptions, lequel changement doit s'effectuer à tous les trois ou quatre ans. Il y a environ 2 500 rideaux au total; en octobre 1982, une cotation de l'extérieur nous montre un coût moyen de 200$ par rideau, pour un coût global d'environ 500 000$. Nous ne sommes pas en mesure de vérifier la rentabilité de ce système, à date, un essai est en cours depuis juin 1983 avec la compagnie "TRANSIGN". Les résultats, après quelques correctifs au niveau conception sont satisfaisants quoique l'on n'ait pas reçu les commentaires du service du Transport, ni des usagers. Deux types de lettrage sont en essai. On envisage également prolonger l'essai avec d'autres fournisseurs, dont "LUMINATOR".

- -

Résultats/Conclusions/Résultats préliminaires:

Résultats non disponibles.

- -

Travail de recherche additionnel identifié:

Project Number: 15
Subject: Vehicle Components/Engines
Submitted by: OC Transpo/Red Pine Instruments

Project Title: Automate Destination and Route Number Curtain Changing

Title of Report: None

Funding Source(s) and % Share: Ministry of Transportation and Communications, (75%), OC Transpo, (25%)

Consultants/Contractors Used: OC Transpo and Red Pine Instruments

Total Project Cost: (all years) $25,000   Total Project Cost: (1983 only) -

Start Date: January 1984   Completion Date: December 1984

Project Manager: W. Jenkins, OC Transpo, (613) 741-6440

Dissemination of Results: OC Transpo internal report

Project Objective, Scope, Background, and Methodology:

The purpose of the project was to maintain the use of high-visibility back-lighted Mylar destination and route number curtains, while providing a single electronic control device to permit the driver to change all seven curtains at the three locations on the bus (front, side, rear). During peak period operation as many as 200 OC Transpo buses are interlined requiring them to change route number and destination displays three or four times as they operate on several different routes. When carried out manually by the driver, this operation requires as much as eight minutes. The use of a driver-activated, automatic changer will eliminate delays and ensure that signs are always changed.

Project Results/Conclusions/Preliminary Findings:

A controller for one sign was installed in 1980. In 1983 - 1984, a controller for all signs in one bus is being installed and tested.

Further Research Work Identified:

Nil

Project Number:	16
Subject:	Vehicle Component
Submitted by:	Montreal Urban Transit Commission

- -

Project Title:	Air Conditioning of Buses		
Title of Report:	None		
Funding Source(s) and % Share:	MUCTC		
Consultants/Contractors Used:	None		
Total Project Cost: (all years)	-	Total Project Cost: (1983 only)	-
Start Date:	-	Completion Date:	-
Project Manager:	Pierre De Villers (514) 877-6079		
Dissemination of Results:			

- -

Project Objective, Scope, Background, and Methodology:

"Prevost" buses and some suburban buses presently have air conditioning. As MUCTC may eventually want to equip all urban buses with air conditioning, MUCTC has asked General Motors to provide an estimate for "Classic" buses. No study or evaluation on service to the customer and on impact on ridership is presently available.

- -

Project Results/Conclusions/Preliminary Findings:

No results available.

- -

Further Research Work Identified:

Numéro du Projet 16
Sujet: Vehicle Components
Soumis par: Commission de transport de la Communauté urbaine de Montréal

Titre du projet: Climatisation des autobus

Titre du rapport: N/A

Source de financement et pourcentage des coûts défrayés par chaque organisme: CTCUM

Consultants/Sous-traitants: Aucun

Coût total: (toutes les années) -

Coût total du projet: (1983 seulement) -

Le projet débute le: -

Fin du projet: -

Directeur du projet: Pierre De Villers (514) 877-6079

Dissémination des résultats:

But, étendue, antécédents et méthodologie du projet:

Les autobus "Prévost" et quelques suburbains sont actuellement avec air climatisé. Pour ce qui est des autobus "Prévost", les fenêtres ne peuvent s'ouvrir, d'où la nécessité d'une climatisation pour un meilleur confort. Les autobus suburbains ont été reçus tel quel et nous permettent d'assurer un service touristique advenant le manque d'autobus "Prévost". En vue d'équiper éventuellement les autobus urbain de climatisation, on a demandé à "G.M." de nous fournir un prix pour l'autobus "Classic". Par contre, aucune évaluation en terme de service à la clientèle et d'augmentation de l'achalandage n'est disponible à ce jour.

Résultats/Conclusions/Résultats préliminaires:

Résultats non disponibles.

Travail de recherche additionnel identifié:

Project Number: 17
Subject: Vehicle Components/Engines
Submitted by: Toronto Transit Commission

Project Title: Floating Frame Truck

Title of Report: Not known

Funding Source(s) and % Share: Toronto Transit Commission/Ontario Ministry of Transportation and Communications

Consultants/Contractors Used: UTDC R & D Ltd.

Total Project Cost: (all years) $2,800,000

Total Project Cost: (1983 only) -

Start Date: February 1983

Completion Date: June 1985

Project Manager: R.E. Smith, UTDC R & D Ltd., (613) 384-3100

Dissemination of Results:

Project Objective, Scope, Background, and Methodology:

Excessive wheel noise and wear on track and wheels for heavy rail vehicles rounding curved sections of track has been a consistent problem for operators of heavy rail systems including the Toronto Transit Commission. A joint UTDC/TTC project will design, build, and test four powered steerable trucks, based on the UTDC floating frame principle. The program includes truck testing and revenue service usage on the TTC subway. Two H5 carbodies will be fitted with the steerable trucks for test purposes. Fatigue tests will be conducted on an extra truck. TTC wil provide the required traction motors, undertake vehicle modifications as designed by UTDC, mount the trucks, and assist in the testing of the cars. TTC will receive four assembled steerable trucks of the floating frame design for pre-services and in-service testing; an additional truck frame for fatigue testing; performance data of the truck developed for TTC; test data analyses; and final reports.

Project Results/Conclusions/Preliminary Findings:

Not yet known.

Further Research Work Identified:

Project Number:	18
Subject:	Vehicle Components/Engines
Submitted by:	Ontario Ministry of Transportation and Communications

- -

Project Title:	Truck Design and Demonstration Program		
Title of Report:	Evaluation and Concept Selection		
Funding Source(s) and % Share:	GO-ALRT (100%)		
Consultants/Contractors Used:	UTDC R & D Ltd.		
Total Project Cost: (all years)	$1,500,000	Total Project Cost: (1983 only)	$750,000
Start Date:	December 16, 1983	Completion Date:	June 30, 1984
Project Manager:	N.W. Kuster, Manager, Operating Equipment, GO Transit, (416) 630-5220		
Dissemination of Results:	Available upon request.		

- -

Project Objective, Scope, Background, and Methodology:

The Urban Transportation Development Corporation Ltd. (UTDC) will test and recommend the truck concept best suited to the GO-ALRT application. The tests will be carried out on the MCL rotary powered truck and the floating frame truck type now being designed for the Toronto Transit Commission subway car application. In parallel with this test and demonstration activity, a review will be carried out of available rigid truck designs which could be utilized for GO-ALRT should the steering trucks not perform satisfactorily. Analysis of all the test results, against GO-ALRT systems requirements, will provide a recommendation as to the best truck concept to be taken to production design for GO-ALRT.

- -

Project Results/Conclusions/Preliminary Findings:

Not yet available.

- -

Further Research Work Identified:

Not yet available.

Project Number:	19
Subject:	Vehicle Components/Engines
Submitted by:	Transportation Development Centre

Project Title: Intermediate Capacity Transit System

Title of Report: None

Funding Source(s) and % Share: Transportation Development Centre (30%)

Consultants/Contractors Used: Quebec Ministry of Transport

Total Project Cost: (all years) $540,000 — Total Project Cost: (1983 only) Nil

Start Date: December 13, 1977 — Completion Date: February 28, 1984

Project Manager: M. Audette, (514) 283-4064

Dissemination of Results:

Project Objective, Scope, Background, and Methodology:

To design, construct, and test two prototype motorized bogies suitably sized for application on an intermediate capacity transit system (ICTS Type Vehicle). The specific objective of this project is to verify that both the physical and the performance characteristics theoretically claimed for the new bogie are achievable. This project will develop hypotheses to be tested and to develop a structured research framework including research organizational structure, procedures, time frame, and costs.

Project Results/Conclusions/Preliminary Findings:

Prototype bogies currently being tested under Bombardier LRV chassis. Final report draft will be submitted for review in March 1984.

Further Research Work Identified:

Project Number: 20
Subject: Vehicle Components/Engines
Submitted by: Bombardier Inc.

Project Title: Light Rail Vehicle Prototype Truck

Title of Report: Not known

Funding Source(s) and % Share: Transportation Development Centre (30%)/Quebec Ministry of Transport (56%)/ Bombardier Inc. (12%)

Consultants/Contractors Used: Dr. Frederic Blader

Total Project Cost: (all years) $2,000,000 | Total Project Cost: (1983 only) $700,000

Start Date: December 1981 | Completion Date: June 1984

Project Manager: André G. Fontaine, Bombardier Inc., (514) 655-3830

Dissemination of Results: Periodics reports to Quebec Ministry of Transport and Transportation Development Centre

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Project Objective, Scope, Background, and Methodology:

The project objective was to develop the technology, to analyse, design, fabricate, and test a fabricated truck designed for light rail vehicle application. Through the project, Dr. Frederic Blader has been acting (for analysis and tests) as a teacher for the truck group. To fabricate the trucks, Bombardier's manufacturing facilities of Valcourt was used. The truck structural tests have been done by CRIQ, while truck tests were done at the AAR test center in Pueblo, Colorado. The results of the tests were used to fine tune the suspensions and to validate computer dynamic programs.

Project Results/Conclusions/Preliminary Findings:

After 2½ years, Bombardier Mass Transit Division has acquired the technology to analyze through several computer programs, design, fabricate, and test the vehicle on track. Test results showed that the three main computer programs are (after adjustment) very accurate, so, they can be used for future designs. Progress on dynamic testing capabilities has also proceeded. See Appendix II for a illustration of the prototype truck.

Further Research Work Identified:

Future truck design development for inter-city rail, high speed rail, and urban transit passenger equipment.

Project Number: 21
Subject: Vehicle Components/Engines
Submitted by: CRIQ/Bombardier Inc./Transportation Development Centre

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Project Title: Bogie Fatigue Tests

Title of Report: Bogie Fatigue Tests

Funding Source(s) and % Share: Transportation Development Centre (100%)

Consultants/Contractors Used: -

Total Project Cost: (all years)	$120,000	Total Project Cost: (1983 only)	$75,000
Start Date:	March 1983	Completion Date:	September 1983

Project Manager: Ginette Delisle

Dissemination of Results: Confidential report - contact Gaston Hébert, Director of R & D, Bombardier Inc.

Project Objective, Scope, Background, and Methodology:

The objective of this experimental analysis is to subject a prototype bogie built by Bombardier Inc. to service requirement, simulating maximum load for a period of 30 years. The experimental analysis is also considered as a mandatory stage following the concept and theoretical calculations of a new design to ensure its reliability and resistance in service. For the analysis, an electrohydraulic system of the type MTS was used to apply all the required forces. About 50 extensometric gauges were installed, principally on the chasis, to measure resistance during use.

Project Results/Conclusions/Preliminary Findings:

This experimental analysis permitted the verification of the reliability of the new bogie and to demonstrate the equivalent and/or the acquisition of European assembly techniques of the welding, tests, and material in contrast with North American materials and techniques. See Appendix II for an illustration of the prototype truck.

Further Research Work Identified:

None.

Numéro du Projet 21
Sujet: Vehicle Components/Engines
Soumis par: CRIQ/Bombardier Inc./TDC

Titre du projet: Essais de fatique/Bogie Bombardier Inc.

Titre du rapport: Essais de Fatigue/Bogie

Source de financement et pourcentage des coûts défrayés par chaque organisme: Centre de développement des Transports, (100%)

Consultants/Sous-traitants: -

Coût total: (toutes les années) $120,000 Coût total du projet: (1983 seulement) $75,000

Le projet débute le: Mars 1983 Fin du projet: Septembre 1983

Directeur du projet: Ginette Delisle

Dissémination des résultats: Rapport confidentiel - Contact: Gaston Hébert, Directeur R & D, Bombardier Inc.

But, étendue, antécédents et méthodologie du projet:

L'objectif de cette analyse expérimentale était de soumettre le prototype d'un châssis de bogie, fabriqué par Bombardier aux sollicitations rencontrées en service, simulant ainsi le cas d'un chargement maximum pour une opération de 30 ans. L'analyse expérimentale est de plus considérée comme étant l'étape obligatoire suivant la conception et les calculs théoriques d'un nouveau design, ce qui permet de s'assurer de la fiabilité et de la résistance en service d'un nouveau design. Pour l'analyse, un système électrohydraulique de marque MTS a été utilisé pour appliquer toutes les forces requises. Une cinquantaine de jauges extensométriques ont été installées principalement sur le chassîs, la plaque oblique de suspension secondaire et sur la traverse danseuse afin de connaître en tout temps le niveau de contraintes présent en cours d'opération. Un système d'acquisition de données contrôlait les paramètres de l'essai et enregistrait en temps voulu les valeurs des contraintes provenant des jauges extensométriques.

Résultats/Conclusions/Résultats préliminaires:

Cette analyse expérimentale a permis de vérifier la fiabilité du nouveau design de même que de démontrer l'équivalence et/ou l'acquisition de techniques européennes d'assemblage, de soudage et d'essais ainsi que des matériaux par rapport aux techniques et matériaux nord-américains. (voir Annexe II).

Travail de recherche additionnel identifié:

Non

Project Number: 22
Subject: Vehicle Components/Engines
Submitted by: Dynamic Sciences Ltd.

Project Title: Two Axle Locomotive Steerable

Title of Report: Truck Development Program

Funding Source(s) and % Share: Bombardier Inc. (100%)

Consultants/Contractors Used: Dynamic Sciences Ltd.

Total Project Cost: (all years) $172,000 — Total Project Cost: (1983 only) $38,000

Start Date: June 1982 — Completion Date: 1984

Project Manager: Pierre Marcotte, (514) 744-5511

Dissemination of Results: Bombardier Inc.

Project Objective, Scope, Background, and Methodology:

Purpose was to develop a better freight locomotive, safer, better ride, and stability. Maximize traction, reduce truck weight, reduce truck and track maintenance and increase fuel efficiency. Two new Bombardier truck concepts were compared to a new proposed truck. Dynamic Sciences Ltd. was required to carry out comparative performance evaluations using computer simulation.

Project Results/Conclusions/Preliminary Findings:

The project is not complete, awaiting additional Bombardier design progress.

Further Research Work Identified:

Not known.

Project Number: 23
Subject: Vehicle Components/Engines
Submitted by: Dynamic Sciences Ltd.

Project Title: Investigation of LRC Coach Wheel Defects

Title of Report: None

Funding Source(s) and % Share: Bombardier Inc. (100%)

Consultants/Contractors Used: Dynamic Sciences Ltd.

Total Project Cost: (all years) $225,000 Total Project Cost: (1983 only) $225,000

Start Date: April 1983 Completion Date: December 1983

Project Manager: Pierre Marcotte, (514) 744-5511

Dissemination of Results: Periodic reviews and reports to Bombardier and Via Rail

Project Objective, Scope, Background, and Methodology:

LRC coaches in service over the past two years have encountered numerous wheel tread defects resulting in premature changeouts and excessive maintenance costs. The objective of the project was to ascertain the cause of these failures in order that necessary remedial action could be taken. A detailed analysis of all railway defect reports was carried out. All elements of the wheel truck suspension and braking system were studied and examined in the field. Electronic monitoring equipment was developed to record brake system component performance in service so that the reason for the wheel failures could be identified.

Project Results/Conclusions/Preliminary Findings:

The investigation revealed serious deficiencies in the wheel slip/slide brake system resulting in high speed wheel skidding and localized wheel stress leading to premature tread failure.

Further Research Work Identified:

Need for improved wheel slide protection on all types of steel wheel passenger vehicles.

Project Number: 24
Subject: Alternative Energy Vehicles/Alternative Fuels
Submitted by: Transportation Development Centre

Project Title: Parallel Hybrid Vehicle

Title of Report: Design and Construction of the Marathon C-36 Parallel Hybrid Vehicle

Funding Source(s) and % Share: National Energy Program, (100%)

Consultants/Contractors Used: Marathon Electric Vehicles Inc.

Total Project Cost: (all years) $67,856

Total Project Cost: (1983 only) $5,000

Start Date: April 2, 1982

Completion Date: March 31, 1984

Project Manager: J. Morgan, (514) 283-4064

Dissemination of Results: -

Project Objective, Scope, Background, and Methodology:

To reduce Canada's dependence on oil-based fuels for road transportation by developing engine/electric hybrid vehicles (parallel drive). To develop a hybrid engine/electric vehicle (EEV) and establish its baseline performance characteristics through test and experimentation. This project will develop hypotheses to be tested and to develop a structured research framework including research organizational structure, procedures, time frame, and costs.

Project Results/Conclusions/Preliminary Findings:

Project complete. Final report draft received.

Further Research Work Identified:

Project Number: 25

Subject: Alternative Energy Vehicles/Alternative Fuels

Submitted by: Transportation Development Centre

- -

Project Title:	Series Hybrid Vehicle		
Title of Report:	Design, Fabrication, and Testing of the Marathon C-360 Series Hybrid Vehicle		
Funding Source(s) and % Share:	National Energy Program, (100%)		
Consultants/Contractors Used:	Marathon Electric Vehicles Inc.		
Total Project Cost: (all years)	$37,544	Total Project Cost: (1983 only)	$2,325
Start Date:	May 19, 1982	Completion Date:	September 30, 1983
Project Manager:	J. Morgan, (514) 283-4064		
Dissemination of Results:	Limited number of copies available from the Transportation Development Centre		

- -

Project Objective, Scope, Background, and Methodology:

To reduce Canada's dependence on oil-based fuels for road transportation by developing engine/electric hybrid vehicles (series drive). To design and construct a series hybrid vehicle so that the operational parameters of such a vehicle might be compared to those of parallel hybrid vehicles. This project will develop hypotheses to be tested and to develop a structured research framework including research organizational structure, procedures, time frame, and costs.

- -

Project Results/Conclusions/Preliminary Findings:

Complete

- -

Further Research Work Identified:

Project Number: 26
Subject: Alternative Energy Vehicles/Alternative Fuels
Submitted by: Transportation Development Centre

Project Title:	Review of Electric Vehicle Operation at SLSA		
Title of Report:	None		
Funding Source(s) and % Share:	Transportation Development Centre, (100%)		
Consultants/Contractors Used:	DSMA Atcon Ltd.		
Total Project Cost: (all years)	$27,000	Total Project Cost: (1983 only)	$1,006
Start Date:	January 31, 1983	Completion Date:	June 30, 1983
Project Manager:	J. Morgan, (514) 283-4064		
Dissemination of Results:	Confidential - not for distribution		

Project Objective, Scope, Background, and Methodology:

To reduce Canada's dependence on imported oil-based fuels used for road transportation by developing electric and hybrid vehicles. To examine service data and retest the SLSA electric vans in order to assess the effect of vehicle modifications and 18 months of additional operation in service of vehicle performance. This project encompasses a series of tests on 7 electric vans which have now completed 2½ years in service. The tests will compare the recent performance of the vehicles to the original performance data.

Project Results/Conclusions/Preliminary Findings:

Report complete (confidential).

Further Research Work Identified:

Project Number:	27
Subject:	Alternative Energy Vehicles/Alternative Fuels
Submitted by:	Transportation Development Centre

Project Title:	Engine Governor Series Hybrid		
Title of Report:	None		
Funding Source(s) and % Share:	National Energy Program, (100%)		
Consultants/Contractors Used:	Controle Industrie		
Total Project Cost: (all years)	$31,717	Total Project Cost: (1983 only)	$31,717
Start Date:	January 17, 1983	Completion Date:	March 31, 1984
Project Manager:	J. Morgan, (514) 283-4064		
Dissemination of Results:	-		

Project Objective, Scope, Background, and Methodology:

To reduce Canada's reliance on imported oil-based fuels by the development of electric and hybrid vehicles and their components. To support the development of an engine governing sub-system to automate and optimize gas engine operation in series hybrid vehicles and test in operation such vehicles. This project encompasses the design, manufacture, bench tests, and road tests of the engine governing sub-system for a series hybrid vehicle, including the assembly of the engine, alternator, transformer/rectifer unit, and controls.

Project Results/Conclusions/Preliminary Findings:

Early results encouraging but company in financial difficulties.

Further Research Work Identified:

Project Number:	28
Subject:	Alternative Energy Vehicles/Alternative Fuels
Submitted by:	Transportation Development Centre

Project Title:	Hybrid Research Vehicle		
Title of Report:	None		
Funding Source(s) and % Share:	National Energy Program, (100%)		
Consultants/Contractors Used:	Marathon Electric Vehicles Inc.		
Total Project Cost: (all years)	$223,463	Total Project Cost: (1983 only)	$76,000
Start Date:	February 4, 1983	Completion Date:	May 31, 1984
Project Manager:	J. Morgan, (514) 283-4064		
Dissemination of Results:	-		

Project Objective, Scope, Background, and Methodology:

To reduce Canada's dependence on imported oil-based fuels by developing engine/electric hybrid vehicles (EEVS) for road transportation. Department of Supply and Services provided funds to undertake research, analysis, development, design and fabrication of an advanced propulsion system for EEVS to determine whether the performance and range of EEVS can be increased sufficiently to displace a significant proportion of gasoline powered vehicles. This project will develop hypotheses to be tested and to develop a structured research framework including research organizational structure, procedures, time frame, and costs.

Project Results/Conclusions/Preliminary Findings:

Phase I complete. Engineering development wholly satisfactory but economics not favourable. Phase II which was to have involved construction will not be undertaken.

Further Research Work Identified:

Project Number: 29
Subject: Alternative Energy Vehicles/Alternative Fuels
Submitted by: Ontario Ministry of Transportation and Communications

Project Title: Electric and Hybrid Vehicle Monitoring

Title of Report: None

Funding Source(s) and % Share: Ontario Ministry of Transportation and Communications, (100%)

Consultants/Contractors Used: None

Total Project Cost: (all years) $4,000 Total Project Cost: (1983 only) -

Start Date: April 1, 1984 Completion Date: March 1, 1985

Project Manager: J. Duncan, Transportation, Technology and Energy Branch/MTC, (416) 248-7141

Dissemination of Results: -

Project Objective, Scope, Background, and Methodology:

Monitor the progress being made in the field of electric and hybrid vehicles used on the roads. This includes trolley and battery buses, flywheel buses, diesel electric buses, and automobiles which utilize electric energy for propulsion. Report on significant developments during the year.

Project Results/Conclusions/Preliminary Findings:

Not yet available.

Further Research Work Identified:

Not yet available.

Project Number: 30
Subject: Alternative Energy Vehicles/Alternative Fuels
Submitted by: Transport Canada

Project Title: Design Modifications SLSA Vans

Title of Report: None

Funding Source(s) and % Share: National Energy Program, (100%)

Consultants/Contractors Used: Transport Canada

Total Project Cost: (all years) $20,000 Total Project Cost: (1983 only) $20,000

Start Date: March 31, 1984 Completion Date: March 31, 1984

Project Manager: J. Morgan, (514) 283-4064

Dissemination of Results: -

Project Objective, Scope, Background, and Methodology:

To reduce Canada's dependence on liquid fuels by continuing a program of development and demonstration of electric and hybrid vehicles. To enhance the performance of the electric vans in SLSA service by undertaking a program of modifications to enhance vehicle performance and improve driver acceptance. The project will comprise the engineering of the modifications and the implementation of the modifications on one vehicle.

Project Results/Conclusions/Preliminary Findings:

One vehicle has been modified and is being test-driven. Satisfactory results to date.

Further Research Work Identified:

Project Number: 31
Subject: Alternative Energy Vehicles/Alternative Fuels
Submitted by: Transportation Development Centre

Project Title: Lower Cost Nickel Zinc Batteries

Title of Report: None

Funding Source(s) and % Share: Transportation Development Centre, (100%)

Consultants/Contractors Used: Cominco Limited

Total Project Cost: (all years) $140,000
Total Project Cost: (1983 only) Nil

Start Date: November 23, 1982
Completion Date: December 31, 1982

Project Manager: J. Morgan, (514) 283-4064

Dissemination of Results: -

Project Objective, Scope, Background, and Methodology:

To develop components to be used in developing lower cost nickel zinc batteries for vehicle applications. A wide range of zinc alloys that are suitable for high speed fabrication will be studied to identify those having the best potential for use as the negative current collector in a nickel-zinc battery. Laboratory experiments will be conducted with the most promising alloys to evaluate their potential battery cycle life through measurements of weight loss and/or corrosion currents. A report will be prepared indicating the feasibility of further work to develop the technology producing lower cost nickel-zinc batteries having better performance in terms of cycle life than present batteries of this type.

Project Results/Conclusions/Preliminary Findings:

Report compete (confidential). In general, very encouraging results.

Further Research Work Identified:

Project Number: 32
Subject: Alternative Energy Vehicles/Alternative Fuels
Submitted by: Transportation Development Centre

Project Title:	Nickel Zinc Battery for Cold Starts		
Title of Report:	None		
Funding Source(s) and % Share:	Department of National Defence/Transportation Development Centre, (50%)/ Cominco Ltd., (50%)		
Consultants/Contractors Used:	Cominco Limited		
Total Project Cost: (all years)	$80,000	Total Project Cost: (1983 only)	$40,000
Start Date:	November 1, 1983	Completion Date:	December 31, 1985
Project Manager:	J. Morgan, (514) 283-4064		
Dissemination of Results:	-		

Project Objective, Scope, Background, and Methodology:

To improve Canadian road transport reliability by developing a high energy nickel zinc battery for cold weather starting of diesel engines. To extend earlier research in nickel zinc batteries into parameters specifically relevant to low-temperature high discharge applications. The project will encompass the examination of various zinc-alkaline alloys involved in the manufacture of plates and current collectors, their assembly into cells, and subsequent testing.

Project Results/Conclusions/Preliminary Findings:

Test of various alloys is currently underway.

Further Research Work Identified:

Project Number: 33
Subject: Alternative Energy Vehicles/Alternative Fuels
Submitted by: Transportation Development Centre

Project Title:	Advanced Charger Electric Vehicle and Engine/Electric Hybrid Vehicles		
Title of Report:	None		
Funding Source(s) and % Share:	National Energy Program, (100%)		
Consultants/Contractors Used:	AC Statpower Inc.		
Total Project Cost: (all years)	$49,915	Total Project Cost: (1983 only)	$16,691
Start Date:	August 22, 1983	Completion Date:	March 31, 1984
Project Manager:	J. Morgan, (514) 283-4064		
Dissemination of Results:	-		

Project Objective, Scope, Background, and Methodology:

To reduce Canada's dependence on imported fuels by advancing the development of engine/electric hybrid vehicles (EEV). To develop an efficient, lightweight microprocessor controlled battery charger which will present a high power factor to the utility line. This project will develop hypotheses to be tested and to develop a structured research framework including research organizational structure, procedures, time frame, and costs.

Project Results/Conclusions/Preliminary Findings:

DC-TO-DC converter received. Balance of equipment to be delivered in March. Tests to date wholly satisfactory.

Further Research Work Identified:

Project Number: 34
Subject: Alternative Energy Vehicles/Alternative Fuels
Submitted by: Transportation Development Centre

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Project Title:	Non-Aqueous Electrolyte Moli		
Title of Report:	None		
Funding Source(s) and % Share:	National Energy Program, (20%)/Department of National Defence, (80%)		
Consultants/Contractors Used:	Department of National Defence		
Total Project Cost: (all years)	$125,000	Total Project Cost: (1983 only)	Nil
Start Date:	January 17, 1984	Completion Date:	March 31, 1985
Project Manager:	J. Morgan, (514) 283-4064		
Dissemination of Results:	-		

- -

Project Objective, Scope, Background, and Methodology:

To reduce Canada's dependence on oil-based fuels by the development of electric vehicles for road transportation. To enhance the performance of electric vehicles by the development of non-aqueous electrolytes for lithium molydenum disulphide batteries, which will improve the performance of such batteries in cold weather. The project will include laboratory tests on at least three solutes, compatibility tests with the Moli battery system, and performance tests of batteries utilizing the new electrolyte.

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Project Results/Conclusions/Preliminary Findings:

Not yet available.

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Further Research Work Identified:

Project Number:	35
Subject:	Alternative Energy Vehicles/Alternative Fuels
Submitted by:	Institut de Recherche d'hydro - Québec

Project Title: ACEP - Research (solid polymer electrolyte batteries)

Title of Report: None

Funding Source(s) and % Share: Institut de Recherche d'hydro - Québec, (80%)

Consultants/Contractors Used: Partners: University Grenoble and Société nationale ELF Aquitaine (SNEA)

Total Project Cost: (all years)	Confidential	Total Project Cost: (1983 only)	Confidential
Start Date:	1978	Completion Date:	1985

Project Manager: Dr. Michel Gauthier

Dissemination of Results: To our partners by meetings (twice a year) and by internal reports

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Project Objective, Scope, Background, and Methodology:

The objective is to develop new Li Batteries based on a ionic conducting polymer for electric vehicle applications and electrical energy storage. Work carried out in France (University of Grenoble and SNEA) and at CRIQ. Research phase consists in the understanding of this new class of materials (their ionic conductivity, stability towards Li, electrochemical and mechanical behaviour) lab work on small systems to evaluate electrodes (+ ne and - ne), their rechargeability (mainly - ne Li electrode), define new electrolytes. Experiments mainly by charging and discharging under controlled conditions; standard electrochemical three electrodes techniques.

Project Results/Conclusions/Preliminary Findings:

Definition of best performing system. Patents applied.

Further Research Work Identified:

Testing electrode (new ways to make Li alloys). Testing new polymers.

Project Number:	36
Subject:	Alternative Energy Vehicles/Alternative Fuels
Submitted by:	Institut de Recherche d'hydro - Québec

Project Title:	Polymers for ACEP (solid polymer electrolyte batteries) Projects		
Title of Report:	Confidential		
Funding Source(s) and % Share:	Institut de Recherche d'hydro - Québec, (80%)		
Consultants/Contractors Used:	Partner: Société nationale ELF Aquitaine (SNEA)		
Total Project Cost: (all years)	Confidential	Total Project Cost: (1983 only)	Confidential
Start Date:	1980	Completion Date:	1986
Project Manager:	Dr. Michel Duval		
Dissemination of Results:	To our partner by meetings (twice a year) and confidential report		

Project Objective, Scope, Background, and Methodology:

To synthesize new and pure polymers to be used in the research and pre-development phases of the ACEP project. Also to develop new tools and equipment to make thin films (IU-50 microns) of composite electrolyte (polymer + additives + electrolyte) and electrodes on a large scale basis (several meters long). Part of the work is performed at University of Montréal using their facilities for polymer synthesis and characterization. Equipment is designed at CRIQ and with consulting firms.

Project Results/Conclusions/Preliminary Findings:

New polymers synthesized in 100 GMS lots; characterization performed (purity, molecular weight distribution, etc.). New equipment under assembly at CRIQ's machine shop and should undergo testing in 1984.

Further Research Work Identified:

Scale up of polymer production; determination of impurity tolerance; define production equipments for thin films.

Project Number: 37
Subject: Alternative Energy Vehicles/Alternative Fuels
Submitted by: Institut de Recherche d'hydro - Québec

Project Title: ACEP - Pre-Development (Polio Polymere Electrolyte Batteries)

Title of Report: Confidential

Funding Source(s) and % Share: Institut de Recherche d'hydro - Québec, (100%)

Consultants/Contractors Used: Partner: Société nationale ELF Aquitaine (SNEA)

Total Project Cost: (all years) Confidential

Total Project Cost: (1983 only) Confidential

Start Date: 1983

Completion Date: 1987

Project Manager: Dr. Michel Gauthier

Dissemination of Results: To our partner by meetings (twice a year) and by confidential reports

Project Objective, Scope, Background, and Methodology:

To develop Li Batteries (rechargeable) for electric vehicle, electrical energy storage and small application (Ni-Cd market). To assemble and test complete encapsulated system using materials developed in the research phase test and develop multi-electrodes system and large surface area prototype evaluation of polymer and electrode fabrication technology.

Project Results/Conclusions/Preliminary Findings:

Emphasis on small rechargeable system operating at room temperature; licensing agreement sought, patents applied.

Further Research Work Identified:

Definition and extensive testing of room temperature, complete prototypes, and low systems for electric vehicle.

Project Number: 38
Subject: Alternative Energy Vehicles/Alternative Fuels
Submitted by: Science Council of British Columbia

Project Title:	Battery Research		
Title of Report:	None		
Funding Source(s) and % Share:	Science Council of British Columbia		
Consultants/Contractors Used:	Department of Physics, University of B.C.		
Total Project Cost: (all years)	$241,000	Total Project Cost: (1983 only)	$12,500
Start Date:	March 1980	Completion Date:	N/A
Project Manager:	Dr. R.R. Haering, (604) 273-0788		
Dissemination of Results:	Through Dr. Haering		

Project Objective, Scope, Background, and Methodology:

To study the use of intercalation systems as cathodes in rechargeable batteries.

Project Results/Conclusions/Preliminary Findings:

Available from Dr. Haering.

Further Research Work Identified:

N/A

Project Number: 39
Subject: Alternative Energy Vehicles/Alternative Fuels
Submitted by: Science Council of British Columbia

Project Title: A Study of Characteristics of Lithium Deposits in Lithium Batteries

Title of Report: None

Funding Source(s) and % Share: Science Council of British Columbia

Consultants/Contractors Used: Moli Energy Ltd.

Total Project Cost: (all years) $247,300
Total Project Cost: (1983 only) $77,600

Start Date: October 1981
Completion Date: N/A

Project Manager: Dr. J. Stiles, (604) 273-0788

Dissemination of Results: Through Moli Energy Ltd.

Project Objective, Scope, Background, and Methodology:

To study growth, corrosion, and dissolution of lithium deposits in lithium batteries.

Project Results/Conclusions/Preliminary Findings:

Confidential to Moli Energy Ltd.

Further Research Work Identified:

N/A

Project Number: 40
Subject: Alternative Energy Vehicles/Alternative Fuels
Submitted by: Department of Mines and Energy, (Nova Scotia)

Project Title: Access-A-Bus Propane Conversion

Title of Report: Access-A-Bus Propane Conversion

Funding Source(s) and % Share: Province of Nova Scotia, (75%)/Metro Transit Commission, Halifax, (25%)

Consultants/Contractors Used: Atlantic Speedy Propane Ltd.

Total Project Cost: (all years) $14,940   Total Project Cost: (1983 only) $14,940

Start Date: June 1, 1983   Completion Date: October 30, 1983

Project Manager: D. Mielke, Metro Transit Commission, Halifax, (902) 421-6600

Dissemination of Results: -

Project Objective, Scope, Background, and Methodology:

The Metro Transit Commission's Access-A-Bus service provides a parallel transit system for ambulatory and non-ambulatory disabled residents of the Halifax-Dartmouth region. The project involves the conversion of the thre 1980 model buses and three new 1983 Wayne/GMC modified buses from gasoline to propane fuel. The expected benefits of this conversion were fuel savings, reduced maintenance costs, cleaner emissions, and better performance.

Project Results/Conclusions/Preliminary Findings:

The project has now been complete for over six months. Initial results show a fuel price decrease of 25%, a fuel use increase of 20%, slight reductions in maintenance costs. Fuel availability has created major difficulties and fueling facility has had to be established at the bus depot. Fuel level gauges have not functioned reliably and this has resulted in buses running out of fuel when the gauge still showed the tank to be one quarter full. Bus range per tank of fuel has been reduced to about 100 miles.

Further Research Work Identified:

Project Number: 41
Subject: Alternative Energy Vehicles/Alternative Fuels
Submitted by: Ontario Ministry of Transportation and Communications

Project Title: Dynomometer Testing of a Heavy Duty Diesel Engine, its Propane Counterpart and a Transit Bus Diesel

Title of Report: -

Funding Source(s) and % Share: Ontario Ministry of Transportation and Communications, (100%)

Consultants/Contractors Used: None

Total Project Cost: (all years) $5,000
Total Project Cost: (1983 only) -

Start Date: June 1, 1984
Completion Date: August 30, 1984

Project Manager: O. Colavincenzo, Transportation, Technology & Energy Branch/MTC, (416) 248-7141

Dissemination of Results: -

Project Objective, Scope, Background, and Methodology:

A commercially available diesel engine, its propane converted counterpart, and a common transit bus diesel engine will be tested on a computer controlled dynamometer. The dynomometer simulate a common bus driven over an Advanced Design Bus (ADB) test cycle for each engine and fuel consumption determined. Other tests involving engine mapping and simple cycles will also be performed.

Project Results/Conclusions/Preliminary Findings:

Not yet available.

Further Research Work Identified:

Not yet available.

Project Number: 42
Subject: Alternative Energy Vehicles/Alternative Fuels
Submitted by: OC Transpo/Ontario Ministry of Transportation and Communications

Project Title: OC Transpo Propane Bus Demonstration

Title of Report: Not known

Funding Source(s) and % Share: Ontario/Canada CREDA, (73%)/OC Transpo, (27%)

Consultants/Contractors Used: OC Transpo as prime contractor/UTDC and R.F. Webb and Associates as consultants

Total Project Cost: (all years) $1,340,340 **Total Project Cost: (1983 only)** $300,000

Start Date: March 1983 **Completion Date:** August 1986

Project Manager: W. Jenkins, OC Transpo, (613) 741-6440

Dissemination of Results: Ontario Ministry of Transportation and Communications, final report September 1986

Project Objective, Scope, Background, and Methodology:

Through a demonstration project investigate the feasibility and cost-effectiveness of operating propane-powered buses in revenue service in an urban municipality. Project initiated in cooperation with Energy, Mines and Resources (Canada) and Ontario Ministry of Energy because of national oil substitution goals and forecast deterioration of diesel fuel specification. Fifteen buses will be equipped with heavy-duty propane engines and wil be operated with standard diesel buses for a two year period. Service and bus storage facilities will be modified to suit propane operation. Personnel will be trained in handling propane fuel and maintaining these engines.

Project Results/Conclusions/Preliminary Findings:

N/A

Further Research Work Identified:

N/A

Project Number: 43
Subject: Alternative Energy Vehicles/Alternative Fuels
Submitted by: Transport Canada

Project Title: Optimization of Propane Engine

Title of Report: Optimization of Propane Engines for Light Duty Vehicles Phase I

Funding Source(s) and % Share: National Energy Program, (100%)

Consultants/Contractors Used: Chrysler Canada Limited

Total Project Cost: (all years) $118,160
Total Project Cost: (1983 only) $59,430

Start Date: February 15, 1982
Completion Date: March 31, 1984

Project Manager: J. Morgan, (514) 283-4064

Dissemination of Results: Limited number of copies available from Transportation Development Centre

Project Objective, Scope, Background, and Methodology:

To reduce Canada's dependence on oil-based by developing more efficient propane burning engines. To undertake the program definition phase of an R & D program to optimize the efficiency of internal combustion engines operation on propane fuel used in automobiles and light duty commercial vehicles. This project will develop hypotheses to be tested and to develop a structured research framework including research organizational structure, procedures, time frame, and costs.

Project Results/Conclusions/Preliminary Findings:

Draft report received. Recommends research in a number of areas.

Further Research Work Identified:

Project Number: 44
Subject: Alternative Energy Vehicles/Alternative Fuels
Submitted by: OC Transpo

Project Title: Preparation of Safety Manual for Propane Use in Buses

Title of Report: Non known

Funding Source(s) and % Share: Transport Canada, (100%)

Consultants/Contractors Used: R.F. Webb and Associates

Total Project Cost: (all years) $30,000
Total Project Cost: (1983 only) $12,000

Start Date: September 1983
Completion Date: June 1984

Project Manager: W. Jenkins, OC Transpo, (613) 741-6440

Dissemination of Results: Transport Canada

Project Objective, Scope, Background, and Methodology:

No single compendium of safety regulations exists for all aspects of the safe handling, operation, and maintenance of propane-powered transit buses. The completion of the manual will form an integral part of our Propane Bus Demonstration Project.

Project Results/Conclusions/Preliminary Findings:

Not yet available.

Further Research Work Identified:

N/A

Project Number: 45
Subject: Alternative Energy Vehicles/Alternative Fuels
Submitted by: Canadian Resourcecon (1983) Ltd.

Project Title: Testing and Demonstration of the Technical and Economic Feasibility of the Use of NGV as a Vehicle Fuel in a Captive Commercial Vehicle Fleet

Title of Report: "NGV, Natural Gas for Vehicles" (Audio Visual)

Funding Source(s) and % Share: Energy, Mines and Resources Canada, (100%)

Consultants/Contractors Used: Canadian Resourcecon (1983) Ltd./Matrix Productions/Black Top Cabs Ltd./Inland Natural Gas Co. Ltd.

Total Project Cost: (all years) $23,000
Total Project Cost: (1983 only) $23,000

Start Date: October 1983
Completion Date: March 1984

Project Manager: Peter T. Midgley, (604) 682-8691

Dissemination of Results: Contact Canadian Resourcecon, (604) 682-8691 or P. Baudry or B. James (EMR), (613) 995-9447 for details on access

Project Objective, Scope, Background, and Methodology:

Video and slide presentations on use of natural gas by dual fuel vehicles are being prepared. The 18 minute video provides a broad review of natural gas in spark ignition engine vehicles and of compressor stations principles, vehicle conversion components, fueling procedures, driving, taxi driver comments, typical users (school bus, commuters, salesman, taxi, RCMP), time fueling versus quick fueling, compressors, storage systems, safety, costs and economic, economic viability determination procedure. Intended for presentation to any "informed layman", the video should be of interest to any individual or group with less than expert knowledge of natural gas use by vehicles. The slide set covers comparable material to the video with restricted coverage of costs and economics.

Project Results/Conclusions/Preliminary Findings:

Further Research Work Identified:

Project Number: ·46
Subject: Alternative Energy Vehicles/Alternative Fuels
Submitted by: Canadian Resourcecon (1983) Ltd.

Project Title:	Testing and Demonstration of the Technical and Economic Feasibility of the Use of NGV as a Vehicle Fuel in a Captive Commercial Vehicle Fleet		
Title of Report:	Use of Natural Gas Fuel by Black Top Cabs, Vancouver, Periodic Reports/Final Report		
Funding Source(s) and % Share:	Energy, Mines and Resources Canada, (100%)		
Consultants/Contractors Used:	Canadian Resourcecon (1983) Limited/Black Top Cabs Limited		
Total Project Cost: (all years)	$125,750	Total Project Cost: (1983 only)	$58,500
Start Date:	October 1982	Completion Date:	September 1984
Project Manager:	P.T. Midgley, (604) 682-8691		
Dissemination of Results:	Periodic and final reports: initially to EMR, after acceptance reports available on request from EMR, Canadian Resourcecon or Black Top.		

Project Objective, Scope, Background, and Methodology:

Black Top Cabs committed to conversion of its 128 car fleet to natural gas in early 1982. In December 1982, the company's compressor station was commissioned. Since that date, the company has displaced over 95% of its gasoline use with natural gas. The study project is designed to collect detailed records on gasoline and natural gas operation of a large taxi fleet. Fuel efficiency is a primary concern, but consideration is also given to maintenance, oil quality, potential valve recession, natural gas conversion components, acceleration, driver attitudes, compressor operating data, and compressor maintenance. Fuel efficiency material includes eight months of gasoline consumption and distance records and will include 16 or 20 months of natural gas data (four months in first periodic report; 12 months in second periodic report).

Project Results/Conclusions/Preliminary Findings:

A large urban taxi can quickly adapt to the use of natural gas as supplied from a fleet operated station. A dramatic saving on fuel cost is achievable. Some drivers initially complain about loss of power, but this is partly overcome as tuning skills and is mitigated by cost savings. Initial data indicates 1.00 kg of natural gas provides the same range as 1.71 of gasoline (6.5 million vehicle km gasoline, 4.1 million vehicle km dual fuel). A HHV energy efficiency improvement of 8.5 percent is thereby indicated for natural gas relative to gasoline.

Further Research Work Identified:

For dual fuel conversion vehicles additional work on power optimization and oil quality currently appears justifiable.

Project Number: 47
Subject: Alternative Energy Vehicles/Alternative Fuels
Submitted by: Science Council of British Columbia

Project Title: The Development of Hardware to Operate Diesel Engines on Natural Gas

Title of Report: None

Funding Source(s) and % Share: Science Council of British Columbia

Consultants/Contractors Used: B.C. Research

Total Project Cost: (all years) $76,724
Total Project Cost: (1983 only) $76,724

Start Date: March 1983
Completion Date: n/a

Project Manager: Dr. D.F. Sheraton, (604) 273-0788

Dissemination of Results: Through B.C. Research

Project Objective, Scope, Background, and Methodology:

Conversion of 6.2 litre G.M. diesel engine to dual-fuel system and evaluation.

Project Results/Conclusions/Preliminary Findings:

N/A

Further Research Work Identified:

N/A

Project Number: 48
Subject: Alternative Energy Vehicles/Alternative Fuels
Submitted by: Science Council of British Columbia

Project Title:	Utilization of Compressed Natural Gas as a Motor Fuel		
Title of Report:	Utilization of Compressed Natural Gas as a Motor Fuel		
Funding Source(s) and % Share:	Science Council of British Columbia		
Consultants/Contractors Used:	B.C. Research		
Total Project Cost: (all years)	$191,150	Total Project Cost: (1983 only)	-
Start Date:	December 1980	Completion Date:	December 1982
Project Manager:	Dr. D.F. Sheraton, (604) 273-0788		
Dissemination of Results:	Through B.C. Research		

Project Objective, Scope, Background, and Methodology:

To investigate the use of natural gas as a motor vehicle fuel. Conversion of vehicles using commercially available kits and evaluation.

Project Results/Conclusions/Preliminary Findings:

Test data of converted vehicles available from B.C. Research.

Further Research Work Identified:

National program supported by EMR.

Project Number: 49
Subject: Alternative Energy Vehicles/Alternative Fuels
Submitted by: Industrial Technology Centre (Manitoba)

Project Title: Alternative Fuel - Vehicle Fleet Testing

Title of Report: None

Funding Source(s) and % Share: Industrial Technology Centre/Manitoba Research Council, (100%)

Consultants/Contractors Used: None

Total Project Cost: (all years) -

Total Project Cost: (1983 only) -

Start Date: December 1980

Completion Date: March 1985

Project Manager: R.P. Shand, Industrial Technology Centre

Dissemination of Results: -

Project Objective, Scope, Background, and Methodology:

Five fleet tests of commercial vehicles using various combinations of ethanol, gasohol, methanol, and isobutanol have been completed or are in progress. The aim of the tests is to determine fuel consumption, driveability, and maintenance data in relation to performance on conventional fuels. In addition, controlled engine and chassis dynamometer tests are used to establish specific fuel consumption comparisons. A comprehensive fuel and lubricant monitoring and analysis program is maintained. Performance at low and high ambient temperatures is detailed.

Project Results/Conclusions/Preliminary Findings:

No results available.

Further Research Work Identified:

Project Number: 50
Subject: Alternative Energy Vehicles/Alternative Fuels
Submitted by: National Research Council

Project Title: Fuel Efficient City Bus

Title of Report: Not known

Funding Source(s) and % Share: National Energy Program, (85%)/National Research Council, (15%)

Consultants/Contractors Used: Contracts not yet arranged

Total Project Cost: (all years) $700,000 | Total Project Cost: (1983 only) $40,000

Start Date: April 1983 | Completion Date: December 1986

Project Manager: A.S. Davies, DME/NRC

Dissemination of Results: NRC reports, SAE papers, etc., bus manufacturers, transit operators

Project Objective, Scope, Background, and Methodology:

To produce a prototype bus with a hydraulic accumulator to recover and re-use most of the braking energy using a bent axis hydraulic pump/motor and an electronic control system.

Project Results/Conclusions/Preliminary Findings:

Calculations have shown that 25% fuel savings can readily be gained in a typical city cycle. There will also be a considerable savings in brake maintenance costs.

Further Research Work Identified:

Complete work above plus consideration of a more sophisticated design to optimize engine operation throughout the driving cycle.

Project Number:	51
Subject:	Alternative Energy Vehicles/Alternative Fuels
Submitted by:	National Research Council

Project Title:	The Operation of Diesel Engines on Alternate Fuels with Development of any Components for these Conditions		
Title of Report:	Not known		
Funding Source(s) and % Share:	National Energy Program/National Research Council Canada, (100%)		
Consultants/Contractors Used:	None		
Total Project Cost: (all years)	$360,000	Total Project Cost: (1983 only)	$73,000
Start Date:	1982	Completion Date:	Ongoing
Project Manager:	G.S. Messenger, (613) 993-2178		
Dissemination of Results:	Within NRC report system		

Project Objective, Scope, Background, and Methodology:

This project consists of instrumenting and calibrating the Ricardo Hydra direct injection diesel engine for a fuel comparison test of current No. 2 diesel fuel versus NRC's 1990's tar sands type fuel. Other sizes and types of diesel engines have been tested by NRC and the Canadian Military on the 1990's fuel. This work will give another source of comparison for understanding the operating behaviour of a future fuels.

Project Results/Conclusions/Preliminary Findings:

Project is still in set-up/calibration phase. Results not yet available.

Further Research Work Identified:

Project Number: 52
Subject: Alternative Energy Vehicles/Alternative Fuels
Submitted by: National Research Council

Project Title:	Diesel Engine Operation on Low Cetane Fuels		
Title of Report:	Effect of Low Cetane Fuels on Diesel Engine Operation: DDA 3-71 engine - SAE 821233 DDA 6V-92T engine - Gulf Research Report		
Funding Source(s) and % Share:	National Energy Program, (60%)/Department of National Defence, (10%)/National Research Council, (30%)		
Consultants/Contractors Used:	Gulf Research, Sheridan Park		
Total Project Cost: (all years)	Not known	Total Project Cost: (1983 only)	$900,000
Start Date:	1980	Completion Date:	Continuing project
Project Manager:	R.B. Whyte		
Dissemination of Results:	NRC reports, contractors reports, published papers - wide circulation to interested parties		

Project Objective, Scope, Background, and Methodology:

Preparation and storage of projected future diesel fuels in quantities large enough for engine tests. Analysis of the hydrocarbons present in fuels and attempts to correlate these with cetane number and other diesel combustion characteristics. Development of computer models of combustion processes and comparison with engine results. Operation of present day engines on low cetane fuels with particular emphasis on combustion data for above correlation work and investigation of feasibility of using lower cetane fuels.

Project Results/Conclusions/Preliminary Findings:

Present findings suggest that from a combustion viewpoint in a warmed up engine 35 cetane fuels would be usable in large diesels (railroad and large truck engines) without major problems.

Further Research Work Identified:

As above, plus effect of low cetane fuels on engine deposits and wear, on cold start, warm-up etc.

Project Number: 53
Subject: Alternative Energy Vehicles/Alternative Fuels
Submitted by: University of B.C., Department of Mechanical Engineering

Project Title: Gaseous Fuels for 2-Stroke Diesel Engines

Title of Report: -

Funding Source(s) and % Share: Not yet finalized

Consultants/Contractors Used: Department of Mechanical Engineering, University of B.C., Vancouver V6T 1W5

Total Project Cost: (all years) -
Total Project Cost: (1983 only) -

Start Date: January 1, 1984
Completion Date: December 31, 1984

Project Manager: Professor R.L. Evans

Dissemination of Results: Upon request

Project Objective, Scope, Background, and Methodology:

The objective of the project is to demonstrate the feasibility of operating a 2-stroke Detroit Diesel engine with natural gas or propane (LPG). A particular design concept has been developed to prevent scavenging of unburnt fuel. The concept will be tested using an engine dynamometer facility.

Project Results/Conclusions/Preliminary Findings:

This project is just starting. If successful, it will enable conversion of bus engines, most of which are 2-strokes, to gaseous fuels such as CNG and LPG.

Further Research Work Identified:

Development of a complete bus conversion system.

Project Number: 54
Subject: Alternative Energy Vehicles/Alternative Fuels
Submitted by: Transport Canada

Project Title: Feasibility of Disc Engine

Title of Report: Direct Injection Stratified Charge Engine Development Final Report

Funding Source(s) and % Share: National Energy Program, (100%)

Consultants/Contractors Used: SNC Inc.

Total Project Cost: (all years) $141,700 Total Project Cost: (1983 only) $10,000

Start Date: March 17, 1983 Completion Date: December 15, 1983

Project Manager: J. Morgan, (514) 283-4064

Dissemination of Results: Limited number of copies available from Transportation Development Centre

Project Objective, Scope, Background, and Methodology:

Reduce Canada's dependence on imported oil-based fuels by developing a direct injection stratified charge (DISC) modification package applicable to Ford 300 cu. in. 6-cyl. currently installed on Econoline van and pickup. To define the theoretical and economic feasibility of the disc engine package as applied to the Ford 300 6 cylinder engine. This project will develop hypotheses to be tested and to develop a structured research framework including research organizational structure, procedures, time frame, and costs.

Project Results/Conclusions/Preliminary Findings:

Project complete. Technical feasibility established but prospects for immediate commercialization not favourable.

Further Research Work Identified:

Project Number: 55
Subject: Alternative Energy Vehicles/Alternative Fuels
Submitted by: Winnipeg Transit

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Project Title: Non-Petroleum Power Sources

Title of Report: Feasibility of Conversion to Non-Petroleum Power Sources

Funding Source(s) and % Share: Manitoba Department of Energy and Mines - EMR, (66%)/City of Winnipeg, (33%)

Consultants/Contractors Used: IBI Group

Total Project Cost: (all years) $150,000   Total Project Cost: (1983 only) -

Start Date: January 1981   Completion Date: 1984

Project Manager: R. Borland, Winnipeg Transit, (204) 284-6930

Dissemination of Results: Limited number of copies available from Winnipeg Transit

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Project Objective, Scope, Background, and Methodology:

Recent increases in fuel costs, coupled with potential reductions in fossil fuel resources, have indicated that alternative forms of energy must be investigated for powering the Winnipeg Transit fleet. The first phase of the study investigated existing and future energy requirements and identified possible energy options. This involves an assessment of transit vehicles using alternative fuels (methanol, propane, natural gas, hydrogen) electrical propulsion, energy storage devices, etc. in comparison with a standard diesel bus. As well, a review of likely demand for future transit services in Winnipeg and on investigation of possible future prices for diesel fuel, electricity, and alternative fuels was undertaken. The above analysis was the basis of an examination of possible combinations of bus and trolley coach routes including operating and capital comparions.

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Project Results/Conclusions/Preliminary Findings:

Winnipeg should adopt, as a conditional goal, the implementation of a trolley coach system. A trolley coach system would be cost effective under the following circumstances: With a 20% capital subsidy, the trolley coach system would be economical today. With a 10% capital subsidy and 1981 diesel fuel prices (33¢/litre), trolley coaches become economical when the total number of vehicles required for service is 115 or more. This represents approximately a 12% increase in ridership over 1981 (assuming an average loading standard of 60 passengers per bus at the maximum load point). With a 10% capital subsidy and no increase in ridership, diesel fuel prices would have to increase to between 39¢ and 42¢ per litre (in 1981 dollars) for the trolley system to be economical. With no capital subsidy, diesel fuel would have to increase to 39¢/litre and ridership on these routes would have to increase by approximately 17% to require a fleet of 120 vehicles on the initial system.

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Further Research Work Identified:

Project Number:	56
Subject:	Alternative Energy Vehicles/Alternative Fuels
Submitted by:	National Research Council

Project Title:	High Energy Density Flywheel Rotor		
Title of Report:	Not known		
Funding Source(s) and % Share:	National Research Council, (85%)/National Sciences and Engineering Research Council (15%)		
Consultants/Contractors Used:	University of Ottawa		
Total Project Cost: (all years)	$850,000	Total Project Cost: (1983 only)	$230,000
Start Date:	June 1980	Completion Date:	March 31, 1985
Project Manager:	J.R.B. Murphy, National Research Council, (613) 993-2024		
Dissemination of Results:	Technology transfer to industrial partner; likely through competitive solicitation		

Project Objective, Scope, Background, and Methodology:

Performance equivalent to a regular internal combustion engine with high overall efficiency can be achieved with a hybrid system comprised of a flywheel and low power source such as fuel cell, battery, or small interal combustion engine. The flywheel is a convenient means by which deceleration energies can be recovered and applied to acceleration requirements. Objective is to select, fabricate and test composite material specimens, and using the acquired data base to select an optimum design and then construct and test a 1 kWh flywheel. The project is aimed at overcoming design limitations of other (non-Canadian) high energy density composite flywheel concepts.

Project Results/Conclusions/Preliminary Findings:

An extensive data base of design concepts, materials characteristics, performance and construction techniques has been assembled and used to select potential candiates for a fibre composite flywheel design. Current efforts are focussed on the fabrication of full-size flywheel rims, hub design and fabrication, and on development of fabrication, and test facilities.

Further Research Work Identified:

The assembled data base will aid the assessment of future developments. A Canadian industrial partner will be identified to carry this work into commercialization.

Project Number:	57
Subject:	Alternative Energy Vehicles/Alternative Fuels
Submitted by:	Transportation Development Centre/Transyt Canada

- -

Project Title: Test Neo-Ken DC Traction Motor

Title of Report: Test of the Neo-Ken DC Traction Motor

Funding Source(s) and % Share: National Energy Program, (100%)

Consultants/Contractors Used: Transyt Canada Inc./University of Toronto, Department of Electrical Engineering

Total Project Cost: (all years)	$10,000	Total Project Cost: (1983 only)	$10,000
Start Date:	January 14, 1983	Completion Date:	November 30, 1983

Project Manager: J. Morgan, (514) 283-4064

Dissemination of Results: Limited number of copies available from TDC

- -

Project Objective, Scope, Background, and Methodology:

To reduce Canada's reliance on imported oil-based fuels by the development of electric and hybrid vehicles and their components. To undertake a test program for the Neo-Ken traction motor and thus support the development of DC traction motors for electric and hybrid vehicles. This project encompasses the setting up and performance of a series of torque, speed, and efficiency tests on the Neo-Ken Motor. Test results to be used by Transyt Canada in the formulation of a methodology and detailed concepts leading to the design of a second generation Transyt Monorail System. The first part of Transyt Canada program concentrates on the above tests involving direct drive DC propulsion systems for city and intercity systems. This effort is concurrent with the final design and preparations for construction of test facility, subsequently upgraded to commercial, financially independent operation.

- -

Project Results/Conclusions/Preliminary Findings:

Further motor tests were recommended as the results, although encouraging, were hampered by inadequate testing equipment, suited more to conventional DC traction machines.

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Further Research Work Identified:

Project Number:	58		
Subject:	Alternative Energy Vehicles/Alternative Fuels		
Submitted by:	Transportation Development Centre		
Project Title:	Re-Test of Neo-Ken DC Motor		
Title of Report:	None		
Funding Source(s) and % Share:	National Energy Program, (50%)/Neo-Ken Electric, (50%)		
Consultants/Contractors Used:	Neo-Ken Electric		
Total Project Cost: (all years)	$15,000	Total Project Cost: (1983 only)	$7,500
Start Date:	January 13, 1984	Completion Date:	March 31, 1984
Project Manager:	J. Morgan, (514) 283-4064		
Dissemination of Results:	-		

Project Objective, Scope, Background, and Methodology:

To reduce Canada's reliance on oil-based fuels by the development of electric vehicles for road transportation. To undertake a test program which would confirm the suitability of the Neo-Ken DC, traction motor for electric vehicle and other transport applications. This project encompasses the setting up and performance of a series of torque, speed, and efficiency tests on the Neo-Ken motor.

Project Results/Conclusions/Preliminary Findings:

Test to be undertaken in March 1984. Results not yet available.

Further Research Work Identified:

Project Number:	59
Subject:	Alternative Energy Vehicles/Alternative Fuels
Submitted by:	Queen's University

Project Title:	Comparative Energy Consumption Study Between LIM and Rotary Drive Systems		
Title of Report:	Same as above		
Funding Source(s) and % Share:	Metro Canada Ltd., UTDC, (100%)		
Consultants/Contractors Used:	None		
Total Project Cost: (all years)	$990	Total Project Cost: (1983 only)	$990
Start Date:	December 1983	Completion Date:	February 1984
Project Manager:	G.E. Dawson with V.I. John, Department of Electrical Engineering, Queen's University,		
Dissemination of Results:	Short report to Metro Canada Ltd.		

Project Objective, Scope, Background, and Methodology:

This short research investigation used the energy management computer simulation model in the Department of Electrical Engineering, Queen's University to determine the energy consumption for a LIM propelled vehicle and a DC rotary traction motor propelled system. Some study of the energy consumption of the DC motor drive with 100% and partial recapture was investigated along with the effect of weight, acceleration, and deceleration.

Project Results/Conclusions/Preliminary Findings:

The energy management model is an effective tool for the investigation of power flow and energy consumption in a transit system. The program is capable of showing the effect on system performance of different drive systems and operating scenarios.

Further Research Work Identified:

Quantification of other transit propulsion systems is required. Analytical techniques are being pursued to determine operating scenarios which will minimize energy consumption.

Project Number: 60
Subject: Alternative Energy Vehicles/Alternative Fuels
Submitted by: Queen's University

Project Title:	Energy Efficient Drives for Transit Systems		
Title of Report:	Same as above		
Funding Source(s) and % Share:	NSERC Strategic Grant, (100%)		
Consultants/Contractors Used:	None		
Total Project Cost: (all years)	$118,650	Total Project Cost: (1983 only)	$39,926
Start Date:	November 1981	Completion Date:	October 1984
Project Manager:	Dr. G.E. Dawson with A.R. Eastham, V.I. John, P.C. Sen, Department of Electrical Engineering, Queen's University		
Dissemination of Results:	Report to NSERC, papers		

Project Objective, Scope, Background, and Methodology:

The main objective of this research is to investigate and to evaluate the energy efficiency of rotary DC, rotary and linear induction and rotary and linear synchronous motor drives for transit vehicles. A comprehensive computer program will be developed to determine the energy efficiency over typical transit vehicle duty cycles. The program will account for the vehicle and route characteristics, train schedule, and the AC/DC electric distribution system.

Project Results/Conclusions/Preliminary Findings:

A program has been developed and applied to energy consumption sensitivity studies, comparative energy consumption of rotary and linear drives, and system receptivity studies. The program has also been used under contract (Metro Canada Limited) to evaluate power flow and energy consumption in the Vancouver ALRT and Detroit CAT systems.

Further Research Work Identified:

Improvement in computation algorithm to increase speed of computation and accuracy of results. Improvements in converter model and incorporation of voltage dependent train load are being pursued. Also under study are the effects of converter induced harmonics in the power distribution system.

Rec'd

Project Number: 61
Subject: Alternative Energy Vehicles/Alternative Fuels
Submitted by: Queen's University

Project Title: Homopolar Linear Synchronous Motor Investigation - An Evaluation of the Homopolar Linear Synchronous Motor for Urban Transit Drive and for Integrated Suspension/Propulsion Applications

Title of Report: Same as above

Funding Source(s) and % Share: Transportation Development Centre, (100%)

Consultants/Contractors Used: Research Coordinator: Canadian Institute of Guided Ground Transport (CIGGT), Queen's University

Total Project Cost: (all years) $106,355 **Total Project Cost: (1983 only)** $60,000

Start Date: June 1982 **Completion Date:** June 1984

Project Manager: A.R. Eastham, Department of Electrical Engineering, Queen's University

Dissemination of Results: Unclassified, available from CIGGT after June 1984

Project Objective, Scope, Background, and Methodology:

The objective of this work was to evaluate the linear homopolar synchronous motor (LHSM) (i) as an alternative to the linear induction motor for urban transit, and (ii) as a machine capable of providing both suspension and propulsion/braking for transportation vehicles. Computer-aided design studies have been conducted using finite element analysis to determine the electromagnetic field distribution in the LHSM, and performance characteristics have been determined from a salient-pole equivalent circuit model of the machine. An LHSM has been designed to meet the performance specifications of UTDC's intermediate capacity transit system for direct comparison with the linear induction motor drive.

Project Results/Conclusions/Preliminary Findings:

The LHSM can be designed to operate at a high power factor-efficiency product, typically of 0.90. This leads to low power conditioner kVA requirements and to excellent energy efficiency. However, the LHSM is considerably larger, 2-3 times heavier and has much higher normal force than a LIM of equivalent performance. While not attractive as an urban transit drive, the HLSM may find application for integration suspension/propulsion systems.

Further Research Work Identified:

The LHSM is of interest for passive guideway Magley vehicles. This and other possible applications should be examined as part of an overall motive power study.

Project Number: 62
Subject: Electrical Distribution Systems
Submitted by: Pannell Kerr Forster Ltd.

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Project Title:	Trolley Overhead Technology Review		
Title of Report:	Trolley Overhead Technology Review		
Funding Source(s) and % Share:	BC Transit, (100%)		
Consultants/Contractors Used:	Pannell Kerr Foster Ltd.		
Total Project Cost: (all years)	$24,180	Total Project Cost: (1983 only)	$18,670
Start Date:	March 1983	Completion Date:	March 1984
Project Manager:	K. Moy, (604) 688-8666		
Dissemination of Results:	-		

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Project Objective, Scope, Background, and Methodology:

Collect and review technical information, opinions, and related experiences with respect to: trolley conductor wire, feederless system, insulated or synthetic guy, elastic overhead suspension system, radio control switches, mercury arc valve, automatic sectionalizing switches, and propose appropriate implementation plan for Vancouver's system.

- -

Project Results/Conclusions/Preliminary Findings:

Not yet available.

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Further Research Work Identified:

Project Number: 63
Subject: Electrical Distribution Systems
Submitted by: Pannell Kerr Forster Ltd.

Project Title:	Rectifier Station Assessment Study		
Title of Report:	BC Transit Trolley System Rectification Stations Plant Evaluation Study		
Funding Source(s) and % Share:	BC Transit, (100%)		
Consultants/Contractors Used:	Pannell Kerr Foster Ltd./Lavalin Ltd.		
Total Project Cost: (all years)	$27,845	Total Project Cost: (1983 only)	Nil
Start Date:	December 1983	Completion Date:	March 1984
Project Manager:	K. Moy, (604) 688-8666		
Dissemination of Results:	BC Transit		

Project Objective, Scope, Background, and Methodology:

Review and assess the condition and maintainability of fourteen DC rectifier stations, identify immediate and long term problems, and recommends corrective action.

Project Results/Conclusions/Preliminary Findings:

Draft report completed.

Further Research Work Identified:

Project Number: 64
Subject: Electrical Distribution Systems
Submitted by: Pannell Kerr Forster Ltd.

Project Title: Trolley Overhead Maintenance System

Title of Report: Trolley Overhead Maintenance System

Funding Source(s) and % Share: BC Transit, (100%)

Consultants/Contractors Used: Pannell Kerr Foster Ltd.

Total Project Cost: (all years) $263,800 Total Project Cost: (1983 only) $200,700

Start Date: October 1982 Completion Date: October 1983

Project Manager: K. Moy/G. Tiller, (604) 688-8666

Dissemination of Results: BC Transit

Project Objective, Scope, Background, and Methodology:

Design, development, and implementation of the computerized trolley overhead maintenance system for: scheduling and reporting periodic and special inspections; generating service orders for maintenance work; processing completed service orders for maintenance control and maintenance history; storing, modifying, and generating computer graphic of overhead for location referencing; reporting maintenance management information.

Project Results/Conclusions/Preliminary Findings:

System has been in operation for two months.

Further Research Work Identified:

Project Number: 65
Subject: Electrical Distribution Systems
Submitted by: Pannell Kerr Forster Ltd.

Project Title: Resolving Outstanding BC Hydro Issues

Title of Report: Trolley Overhead Maintenance System - Implementation Plan

Funding Source(s) and % Share: BC Transit, (100%)

Consultants/Contractors Used: Pannell Kerr Foster Ltd.

Total Project Cost: (all years) $54,000 Total Project Cost: (1983 only) $49,000

Start Date: June 1983 Completion Date: February 1984

Project Manager: R.D. Leighton/K. Moy, (604) 688-8666

Dissemination of Results: BC Transit

Project Objective, Scope, Background, and Methodology:

To transfer maintenance, capital construction, and ownership responsibilities for the trolley overhead and DC rectification system from the utility company, BC Hydro and Power Authority to government transit agencies, BC Transit and Metro Transit Operating Company and private electrical contractors.

Project Results/Conclusions/Preliminary Findings:

Various functions, inventory and asset associated with the trolley overhead and rectification system were successfully transfered.

Further Research Work Identified:

Project Number:	66
Subject:	Electrical Distribution Systems
Submitted by:	Montreal Urban Transit Commission

Project Title:	Automatic Re-closing of Circuit Breaker Rectifier Substations		
Title of Report:	None		
Funding Source(s) and % Share:	MUCTC		
Consultants/Contractors Used:	None		
Total Project Cost: (all years)	$150,000	Total Project Cost: (1983 only)	$10,000
Start Date:	January 1, 1980	Completion Date:	December 31, 1984
Project Manager:	Guy L. Desnoyers (514) 877-3909		
Dissemination of Results:			

Project Objective, Scope, Background, and Methodology:

The purpose of this project is to establish automatic re-closing of DC Current circuit breakers in the initial subway network. Particular attention will be given to the design process to prevent future work from causing a reduction of service to passengers. An automatic re-closing device is used in subway extensions but the controls are very different and it is impossible to use a similar device in the initial subway network.

Project Results/Conclusions/Preliminary Findings:

No results available.

Further Research Work Identified:

Numéro du Projet	66
Sujet:	Electrical Distribution Systems
Soumis par:	Commission de transport de la Communauté urbaine de Montréal

Titre du projet:	Réenclenchement automatique des disjoncteurs des postes de redressement du réseau initial du métro		
Titre du rapport:	Aucun		
Source de financement et pourcentage des coûts défrayés par chaque organisme:	CTCUM		
Consultants/Sous-traitants:	Aucun		
Coût total: (toutes les années)	$150,000	Coût total du projet: (1983 seulement)	$10,000
Le projet débute le:	1 janvier, 1980	Fin du projet:	31 décembre, 1984
Directeur du projet:	Guy L. Desnoyers (514) 877-3909		

Dissémination des résultats:

But, étendue, antécédents et méthodologie du projet:

L'objectif du projet est le réenclenchement automatique des disjoncteurs à courant continu dans le réseau initial du métro. Ce projet nécessite de porter une attention particulière à l'étape design car le système est en opération et les travaux futurs ne doivent pas provoquer une baisse dans la qualité du service des voyageurs. Nous avons dans le réseau des prolongements (1976) un appareil de réenclenchement automatique mais les contrôles sont très différents et conséquement il est impossible de copier directement cet appareil dans le réseau initial.

Résultats/Conclusions/Résultats préliminaires:

Résultats non disponibles.

Travail de recherche additionnel identifié:

Project Number: 67
Subject: Electrical Distribution Systems
Submitted by: Montreal Urban Transit Commission

Project Title: Comparison of Short Circuit Detectors

Title of Report: None

Funding Source(s) and % Share: MUCTC (100%)

Consultants/Contractors Used: None

Total Project Cost: (all years) $20,000
Total Project Cost: (1983 only) $20,000

Start Date: March 1, 1983
Completion Date: December 31, 1983

Project Manager: Guy L. Desnoyers (514) 877-3909

Dissemination of Results: 6th Symposium of Rubber Tired Subways

Project Objective, Scope, Background, and Methodology:

The purpose of the project is to find a substitute for the BBC detector type PCC being used at the MUCTC for the last 9 years. The detector is very effective but the cost is prohibitive. A substitute will be recommended for extensions or even as a replacement of the PCC. Documenting studies, laboratory tests, statistical sampling and testing of circuit breakers of type interrupted ARC with 3UB 51 of Siemens, RATP 78, of Cerme and DDL-ACA 11 of BBC Sécheron was carried out.

Project Results/Conclusions/Preliminary Findings:

The three detectors studied have not spotted the defects in the interrupted arc. Study concluded that the detector DDL-ACA 11 is the most effective of the three detectors studied because it has greater adjustment flexibility and could be modified with an interrupted arc detection. It would then be a proper replacement for the PCC.

Further Research Work Identified:

Numéro du Projet 67
Sujet: Electrical Distribution Systems
Soumis par: Commission de transport de la Communauté urbaine de Montréal

- -

Titre du projet: Essai comparatif de détecteurs de court-circuit

Titre du rapport: Aucun

Source de financement et pourcentage des coûts défrayés par chaque organisme: CTCUM

Consultants/Sous-traitants: -

Coût total: (toutes les années) $20,000
Coût total du projet: (1983 seulement) $20,000

Le projet débute le: 1 mars, 1983
Fin du projet: 31 décembre, 1983

Directeur du projet: Guy L. Desnoyers (514) 877-3909

Dissémination des résultats: VI Symposium des métros sur pneumatiques à Mexico 1984

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But, étendue, antécédents et méthodologie du projet:

L'objectif visé par le projet est de trouver un détecteur de court-circuit qui serait un substitut adéquat au détecteur de BBC de type PCC qui est en opération dans notre réseau depuis neuf (9) ans. Le détecteur est très performant mais son coût d'achat est exorbitant. Ce substitut sera recommandé pour les prolongements ou même en remplacement éventuel du PCC. La méthodologie utilisée dans ce projet est constitué des quatres étapes suivantes: étude de documentation, essais en laboratoire, relevés statistiques essais de court-circuit du type arc-interrompu avec les détecteurs 3UB 51 de Siemens, RATP 78 de Cerme et DDL-ACA 11 de BBC Sécheron.

- -

Résultats/Conclusions/Résultats préliminaires:

Les trois détecteurs n'ont pas détecté les défauts d'arc-interrompu. Nous croyons que le détecteur DDL-ACA II qui est le plus performant des trois, parce qu'il a une plus grande flexibilité de réglage, pourrait être modifié avec une détection d'arc-interrompu. Il serait alors un substitut adéquat au PCC.

- -

Travail de recherche additionnel identifié:

Project Number: 68
Subject: Electrical Distribution Systems
Submitted by: Montreal Urban Transit Commission

Project Title: Analysis of the Operation of Subway Manoeuver Station

Title of Report: Chronological Event Recorders at Manoeuver Stations

Funding Source(s) and % Share: MUCTC

Consultants/Contractors Used: None

Total Project Cost: (all years) $200,000
Total Project Cost: (1983 only) -

Start Date: January 1984
Completion Date: January 1987

Project Manager: Jean-Denis Pelletier (514) 877-6077

Dissemination of Results:

Project Objective, Scope, Background, and Methodology:

Installation of chronological event recorders at relay rooms of subway manoeuver stations to facilitate the location of power failures on the subway signalizing network.

Project Results/Conclusions/Preliminary Findings:

No results available.

Further Research Work Identified:

Numéro du Projet	68
Sujet:	Electrical Distribution Systems
Soumis par:	Commission de transport de la Communauté urbaine de Montréal

Titre du projet:	Analyses du fonctionnement des postes de manoeuvre du métro		
Titre du rapport:	Enregistreurs chronologiques d'événements aux stations de manoeuvre		
Source de financement et pourcentage des coûts défrayés par chaque organisme:	CTCUM		
Consultants/Sous-traitants:	Aucun		
Coût total: (toutes les années)	$200,000	Coût total du projet: (1983 seulement)	-
Le projet débute le:	Janvier 1984	Fin du projet:	Janvier 1987
Directeur du projet:	Jean-Denis Pelletier (514) 877-6077		
Dissémination des résultats:			

But, étendue, antécédents et méthodologie du projet:

Implantation d'enregistreurs chronologiques d'événements aux postes de relais des stations de manoeuvre du métro afin de faciliter la recherche des causes des pannes sur le réseau de signalisation du métro.

Résultats/Conclusions/Résultats préliminaires:

Résultats non disponibles.

Travail de recherche additionnel identifié:

Project Number: 69
Subject: New System Development
Submitted by: Transport Canada

Project Title:	Sail Rail Transportation System Development		
Title of Report:	None		
Funding Source(s) and % Share:	National Energy Program, (100%)		
Consultants/Contractors Used:	Urban Transportation Development Corporation		
Total Project Cost: (all years)	$287,581	Total Project Cost: (1983 only)	$100,000
Start Date:	July 16, 1983	Completion Date:	October 31, 1984
Project Manager:	C.A. Versailles, (514) 283-4064		
Dissemination of Results:	-		

Project Objective, Scope, Background, and Methodology:

To develop and demonstrate an experimental transportation system based upon Sail Rail air bearing technology and linear induction motor (LIM) propulsion. The ability to operate in an unprotected environment, ability to negotiate curved rail, the feasibility of switching and vehicle control will be identified and design solutions will be developed and evaluated on an experimental system. A Canadian corporation, SailRail Enterprises, has developed thi technology for the materials handling industry and for the transport of freight. UTDC - R & D has submitted a proposal to evaluate the potential for shuttle transport services.

Project Results/Conclusions/Preliminary Findings:

Detailed design, prototype system, operational demonstration, technical report; see Appendix III for an illustration of an air bearing passenger vehicle.

Further Research Work Identified:

Project Number: 70
Subject: New System Development
Submitted by: Transyt Canada

Project Title: Las Vegas - Los Angeles Fast Rail Link

Title of Report: Las Vegas - Los Angeles High Performance Passenger/Cargo Transportation System (Feasibility Proposal)

Funding Source(s) and % Share: Transyt Canada, (100%)

Consultants/Contractors Used: Universal Transit Systems Development Corporation (UTSDC)

Total Project Cost: (all years) N/A
Total Project Cost: (1983 only) N/A

Start Date: January 1983
Completion Date: June 1983

Project Manager: Martin Mizera, (416) 226-9112

Dissemination of Results: Internal and City of Las Vegas

Project Objective, Scope, Background, and Methodology:

The project objective was to present a viable alternative (same travel time) to a proposed TRANSRAPID and other systems for the Las Vegas - Los Angeles route, based on computer performance simulation, operational research and economic and social realities of the project. A performance-simulator computer software was developed (to be used in all future route simulations), tested and used to help conclude the project viability.

Project Results/Conclusions/Preliminary Findings:

As a result of the study, it was concluded that a suspended intercity monorail system is cheaper to build and operate, lighter, environmentally unobtrusive and provides vastly superior expansion capabilities (all as opposed to TRANSRAPID). The methodology was affirmed. Stating the equal total travel time as a basis of comparison for transportation systems rather that the maximum speed, demanding inordinate complexity, energy consumption, construction and maintenance costs, with increased financial burden on the taxpayers.

Further Research Work Identified:

Further development of the system was requested and undertaken, capable of expansion to surrounding municipalities.

Project Number: 71
Subject: New System Development
Submitted by: Transyt Canada

Project Title: TranSyt Monorail Urban Car Study

Title of Report: Not known

Funding Source(s) and % Share: Transyt Canada, (100%)

Consultants/Contractors Used: Institute for Aerospace Studies, University of Toronto

Total Project Cost: (all years) N/A
Total Project Cost: (1983 only) N/A

Start Date: June 1983
Completion Date: December 1984

Project Manager: Martin Mizera, (416) 226-9112

Dissemination of Results: Not determined

Project Objective, Scope, Background, and Methodology:

The scope of the project is the optimization of an urban monorail car based on TranSyt design and operational philosophy. A car dynamics study is under way and a study of thermal stability and comfort. Other components of the project are: structural car development, manufacturing and assembly techniques, a detailed human factor based passenger comfort study and an aerodynamics study followed by the prototype car development in Toronto.

Project Results/Conclusions/Preliminary Findings:

The preliminary findings are yet to be consolidated, considering the complexity of subsystem designs and their interactions. The refinements of passenger comfort criteria, specific to a suspended system were achieved and resulted in structural improvements. The design and manufacture of the monorail passenger car is more adapted to the techniques of the aerospace industry than that of surface transport. This also reflects favourably into manufacturing costs.

Further Research Work Identified:

Project Number: 72
Subject: New System Development
Submitted by: Transyt Canada

Project Title: TranSyt Monorail Urban Station Study

Title of Report: Preliminary Report on Station Design Concept

Funding Source(s) and % Share: Transyt Canada, (100%)

Consultants/Contractors Used: Arthur C.F. Lau

Total Project Cost: (all years) N/A
Total Project Cost: (1983 only) N/A

Start Date: October 1981
Completion Date: December 1984

Project Manager: Lyman Richardson, (416) 226-9112

Dissemination of Results: Internal

Project Objective, Scope, Background, and Methodology:

The development of a single car length monorail station based on close arrivals, shorter stop times, and unidirectional passenger flows. Analysis of three basic station types: standard stations, single-direction and off-line stations, and interchange stations. Formulation of detailed functional and operational requirements, including passenger demand control, fare collection system, automatic car docking system and station climate control.

Project Results/Conclusions/Preliminary Findings:

A functional and modern station is being developed, being a part of the transportation system rather than an addition to it. A single car length station will reduce walking distances, large land acquisition and construction costs, increase the safety and security and, therefore, public acceptance. Stations will be amenable to licensing of various enterprises by the city, easily accessible, and its control and monitoring systems will be incorporated into the central control system, including the revenue control.

Further Research Work Identified:

Project Number: 73
Subject: New System Development
Submitted by: Transyt Canada

Project Title: TranSyt Monorail Guideway Study

Title of Report: Guideway Design - Engineering Study

Funding Source(s) and % Share: Transyt Canada, (100%)

Consultants/Contractors Used: Fodor Engineering Ltd.

Total Project Cost: (all years) N/A

Total Project Cost: (1983 only) N/A

Start Date: September 1982

Completion Date: June 1983

Project Manager: Lyman Richardson/Martin Mizera, (416) 226-9112

Dissemination of Results: Internal

Project Objective, Scope, Background, and Methodology:

A detailed analysis of a lightweight truss steel structure as applied to elevated rapid rail transit was made. This study involved proof of concept and an analysis of typical guideway spans and pylon spacings, pylon arms, pylons and their foundations, rail fastening system, thermal contraction/expansion and typical welded connections. A classification of switches was also made and their technical specifications formulated.

Project Results/Conclusions/Preliminary Findings:

The study resulted in an alternative solution to a heavy concrete guideway (weight ratio 15-20:1) at a greatly reduced cost and pylon separation increased to 45 m. The analysis of guideway deflections (augmented by standard fabrication techniques) has shown that the ride comfort is equivalent to that of a concrete guideway and the vehicle acts as a unique device damping the guideway oscillations by the presence of its considerable mass. As opposed to the older steel guideways, this one is quieter due to the absence of large radiating surfaces. Visual obtrusion is also reduced. This type of guideway greatly simplifies manufacturing, expedites route construction, and facilitates relocatability when transportation demand patterns change, thereby reducing the continuing costs of an entire transportation system.

Further Research Work Identified:

Project Number: 74
Subject: New System Development
Submitted by: Transyt Canada

Project Title: TranSyt Monorail Bogie Design Study

Title of Report: Completion Report of the TranSyt Monorail Bogie Design

Funding Source(s) and % Share: Transyt Canada, (100%)

Consultants/Contractors Used: Julius Nagy & Associates Engineering Ltd./
Ceeco Machinery Manufacturing Ltd.

Total Project Cost: (all years) N/A
Total Project Cost: (1983 only) N/A

Start Date: June 1982
Completion Date: February 1983

Project Manager: Lyman Richardson/Martin Mizera, (416) 226-9112

Dissemination of Results: Internal

Project Objective, Scope, Background, and Methodology:

The project objective was to design a suspended monorail bogie featuring light weight, state-of-the-art suspension, superior steel-to-steel traction and dynamics, as well as competitive costs, using easily available, proven components to reduce maintenance and operational costs involved. This first generation urban-type bogie uses a non-direct drive DC propulsion system, two-stage air spring suspension and resilient wheels, as well as the car stabilizing and swing control systems. The bogie was to be considered an interface and a part of the guideway rather than as part of the vehicle.

Project Results/Conclusions/Preliminary Findings:

The bogie designed differs from conventional designs through the use of uniquely sloped wheels ("wedge effect"). There are no rigid axles between wheels and the only coupling is through the propulsion electronics ("electronic axle"), providing a much quieter ride and superior stability when negotiating curves and a better controlled straight line behaviour. The dependence on wheel flanges is greatly reduced, the traction is improved due to the elevation and slope of the rail (stays clean) and an additional 15.5% traction gain is achieved due to slope of the wheel, regardless of conditions. This allows the car to be 15.5% lighter to maintain the same level of traction, improves its gradeability, and where passenger comfort allows it, improves vehicle dynamics to reduce travel time. This type of bogie is to be used in the TranSyt monorail prototype.

Further Research Work Identified:

Project Number: 75
Subject: New System Development
Submitted by: Transportation Development Centre

Project Title: Harmonics and Unbalance in Linear Induction Motors

Title of Report: None

Funding Source(s) and % Share: Transportation Development Centre, (100%)

Consultants/Contractors Used: Queen's University - CIGGT

Total Project Cost: (all years) $58,800 Total Project Cost: (1983 only) Nil

Start Date: February 23, 1984 Completion Date: October 31, 1985

Project Manager: C.A. Versailles, (514) 283-4064

Dissemination of Results: -

Project Objective, Scope, Background, and Methodology:

To develop non-contact propulsion technology for future use in either conventional or non-conventional transportation systems. To develop an analytical model to evaluate the effects and consequences of time harmonic and phase unbalance in the power supply of LIM's on their performance. The scope of this project will be limited to analytical studies and experimental work on a single-sided linear induction motor with both a solid-steel and an aluminum-capped-steel reaction rail. All the equipment needed for this project is available at CIGGT.

Project Results/Conclusions/Preliminary Findings:

Not yet available.

Further Research Work Identified:

Project Number: 76
Subject: New System Development
Submitted by: Transport Canada

- -

Project Title: Sixty HZ Linear Induction Motor

Title of Report: None

Funding Source(s) and % Share: Transportation Development Centre, (100%)

Consultants/Contractors Used: Urban Transportation Development Corporation Ltd.

Total Project Cost: (all years) $492,673 Total Project Cost: (1983 only) $257,673

Start Date: June 3, 1983 Completion Date: November 30, 1984

Project Manager: M. Audette, (514) 283-4064

Dissemination of Results: -

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Project Objective, Scope, Background, and Methodology:

The objective of this project is to develop a low-cost rugged linear induction motor (LIM) propulsion system powered by commercial 60 Hz power. Recently TDC conducted a feasibility study that compared the operational requirements of an airport people mover and the performance specifications of the intermediate capacity transit system (ICTS) of the Urban Transportation Development Corporation (UTDC). The study concluded that ICTS, with some modifications, is suitable for the airport application, and a considerable cost improvement is achievable if the linear motor could be powered directly from commercial 60 Hz frequency. UTDC then undertook a design-oriented analysis of a field frequency, variable voltage, linear propulsion system. Computer predictions of motor performance were developed and cost/performance trade-offs studied. Comparisons were made of the costs of the commercial frequency approach and the variable frequency approach for a typical airport people mover application. The principal conclusion reached was the advantages offered by commercial frequency, variable voltage control LIM propulsion does not justify the extra capital and energy costs incurred for airport people mover applications. UTDC is now investigating the possibility of placing the LIM primaries on the track and having the traction member vehicle-borne; this configuration is referred to as "short primary/discrete secondary" or SP/DS. The SP/DS LIM configuration has several inherent features that distinguish it from the more traditional track-side reaction rail design and that may be of considerable practical importance in certain low-speed applications. In the SP/DS configuration commercial frequency may be used without incurring excessive costs. The results of this project are expected to provide an attractive motor propulsion system for a range of automated, all-weather transportation applications such as airport people movers, freight handling systems, medium-speed line haul passenger applications and mine haulage systems.

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Project Results/Conclusions/Preliminary Findings:

Not yet available.

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Further Research Work Identified:

Project Number: 77
Subject: New System Application
Submitted by: Transportation Development Centre

Project Title: Research Design ALRT Impact

Title of Report: None

Funding Source(s) and % Share: Transportation Development Centre, (50%)/BC Transit, (50%)

Consultants/Contractors Used: BC Transit

Total Project Cost: (all years) $60,000   Total Project Cost: (1983 only) $30,000

Start Date: June 3, 1983   Completion Date: May 20, 1984

Project Manager: L. Suen, (514) 283-4100

Dissemination of Results: Mostly for internal use of BC Transit and TDC, copies available on request

Project Objective, Scope, Background, and Methodology:

To evaluate the Canadian Advanced Light Rail Transit (ALRT) Technology development for technology transfer purposes nationally and internationally. To develop a research design for the comprehensive and systematic evaluation of th impact of ALRT system on the Vancouver Metropolitain area.

Project Results/Conclusions/Preliminary Findings:

This project developed hypotheses to be tested and a structured research framework including research organizationa structure, procedures, time frame, and costs.

Further Research Work Identified:

To conduct a comprehensive evaluation of the impact of ALRT in Vancouver over a 10 year time framework.

Project Number:	78
Subject:	New System Application
Submitted by:	Transportation Development Centre

Project Title:	Impact Assessment Sea-Bus		
Title of Report:	Sea-Bus Technology Volume 1 - System Documentation, Volume II - Impact Evaluation, Summary Report		
Funding Source(s) and % Share:	Transportation Development Centre, (83%)/National Energy Program, (17%)		
Consultants/Contractors Used:	Lavalin Inc.		
Total Project Cost: (all years)	$149,080	Total Project Cost: (1983 only)	$89,144.53
Start Date:	November 6, 1982	Completion Date:	December 31, 1983
Project Manager:	L. Suen, (514) 283-4100		
Dissemination of Results:	-		

Project Objective, Scope, Background, and Methodology:

This study will document and evaluate a successful intermodal transportation development to facilitate similar applications, through technology transfer, in Canada and internationally. To provide a comprehensive and systematic documentation of the Burrard Inlet Sea-Bus technology and system for the national and international transportation community.

Project Results/Conclusions/Preliminary Findings:

Volume One provides a complete documentation of the technologies utilized in the Sea-Bus vessels and terminals. Volume Two addresses the primary and secondary impacts of the system in the areas of transportation, economics, urban development, and harbour environment.

Further Research Work Identified:

Nil

Project Number: 79
Subject: New System Application
Submitted by: Queen's University

- -

Project Title: Energy Management and Load Flow Study for the Revised Detroit CAT System

Title of Report: Energy Management and Load Flow Study for the Revised Detroit CAT System

Funding Source(s) and % Share: Metro Canada Ltd. (UTDC), (100%)

Consultants/Contractors Used: Research Contractor: Canadian Institute of Guided Ground Transport (CIGGT), Queen's University

Total Project Cost: (all years) $7,645   Total Project Cost: (1983 only) $7,645

Start Date: September 1983   Completion Date: December 1983

Project Manager: V.I. John with G.E. Dawson, Department of Electrical Engineering, Queen's Universit

Dissemination of Results: Report to Metro Canada Ltd.

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Project Objective, Scope, Background, and Methodology:

The energy management computer program in the Department of Electrical Engineering, Queen's University was used to simulate the power flow in the Detroit Central Automated Transit System feeder and distribution lines. The results of the research investigation were used to verify the substation ratings and locations and to evaluate the effect of regeneration on energy consumption. The effects on energy consumption of modified speed restrictions, train schedule, and power rail testing with normal and abnormal substation operation were also considered. Since the system involved running trains in a continuous loop the previous programs had to be modified to take this fact into account.

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Project Results/Conclusions/Preliminary Findings:

A thorough study of the transit system operation must be made to determine nominal and peak power flow in the system. The rating of substations must be sufficient to handle a fully loaded system under abnormal power supply scenarios. Some improvements in energy consumption can be realized with simple changes in speed restrictions with only small increases in trip time.

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Further Research Work Identified:

Improvements in the speed and accuracy of the computer algorithm and the inclusion of additional system details were identified as areas of future work.

Project Number:	80
Subject:	New System Application
Submitted by:	Queen's University

Project Title:	Vancouver ALRT Substation Sizing		
Title of Report:	Vancouver ALRT Substation Sizing		
Funding Source(s) and % Share:	Metro Canada Ltd. (UTDC), (100%)		
Consultants/Contractors Used:	Research Contractor: Canadian Institute of Guided Ground Transport (CIGGT), Queen's University		
Total Project Cost: (all years)	$5,716.39	Total Project Cost: (1983 only)	$5,716.39
Start Date:	January 1983	Completion Date:	February 1983
Project Manager:	G.E. Dawson with V.I. John, Department of Electrical Engineering, Queen's University		
Dissemination of Results:	Report to Metro Canada Ltd.		

Project Objective, Scope, Background, and Methodology:

A number of scenarios of train schedules, train consists, number of operating substations, and time interval for the investigation of power flow and energy consumption of the Vancouver ALRT system were run to determine the electrical rating of the transit system substations. This research study was accomplished through the use of the energy management computer model in the Department of Electrical Engineering, Queen's University.

Project Results/Conclusions/Preliminary Findings:

The computer simulation model is capable of simulating a wide range of operating scenarios on the transit system. From this study, it was possible to ensure that the substation electrical rating would be sufficient to withstand all normal and abnormal operating conditions.

Further Research Work Identified:

The converter model details in the AC/DC system model are the subject of further development.

Project Number: 81
Subject: New System Application
Submitted by: Queen's University

Project Title: Power Distribution Receptivity Study

Title of Report: Power Distribution Receptivity Study

Funding Source(s) and % Share: Metro Canada Ltd. (UTDC), (100%)

Consultants/Contractors Used: None

Total Project Cost: (all years) $1,965 Total Project Cost: (1983 only) $1,965

Start Date: November 1983 Completion Date: December 1983

Project Manager: V.I. John with G.E. Dawson, Department of Electrical Engineering, Queen's University

Dissemination of Results: Short report to Metro Canada Ltd.

Project Objective, Scope, Background, and Methodology:

This research investigation was concerned with the determination of voltages and power in the Vancouver ALRT transi distribution system. The energy management program in the Department of Electrical Engineering, Queen's University was used to determine the effects of a number of train schedules and substation locations. The program accounted for the unidirectional flow of substation power using an interactive technique when solving the distribution power flows.

Project Results/Conclusions/Preliminary Findings:

High voltage peaks are possible when the system is lightly loaded. The number and magnitude of the voltage peaks during a particular time interval depends on the number of trains, the schedule, and substation locations.

Further Research Work Identified:

A more comprehensive study could be considered to determine voltage conditions over a wide range of system operatio (normal and abnormal). A study of peak voltage reducing techniques may be worthwhile.

Project Number:	82
Subject:	Safety and Product Qualification
Submitted by:	Transportation Development Centre

Project Title:	School Bus Safety		
Title of Report:	School Bus Safety		
Funding Source(s) and % Share:	Transportation Development Centre, (100%)		
Consultants/Contractors Used:	TES Limited		
Total Project Cost: (all years)	$30,000	Total Project Cost: (1983 only)	$30,000
Start Date:	July 1983	Completion Date:	April 1984
Project Manager:	Trevor Smith, (514) 283-7682		
Dissemination of Results:	Copies of final report available from the Transportation Development Centre		

Project Objective, Scope, Background, and Methodology:

To investigate, evaluate, refine, and test design improvements, to increase safety inside school buses. In order to achieve the specific project objective, the work will encompass analyses of existing accident statistics, testing, and evaluation of particular design improvements. Detailed costing as well as liaison with appropriate manufacturers is included.

Project Results/Conclusions/Preliminary Findings:

Even though this project has resulted in a retrofit kit (for upgrading older seats) being developed and tested, the conclusion from this research is that safety investment in school bus transportation would be more cost-effective in driver selection/training.

Further Research Work Identified:

A public education program (for parents, children, school boards, bus operators, etc.) is recommended in order to convey the relative safety of school bus transportation and cost-effective methods of ensuring school bus safety.

Project Number: 83
Subject: Vehicle/System Market Research
Submitted by: Transportation Development Centre

Project Title: Sail Rail Transit Application

Title of Report: Application of SailRail Technology to the Transit Industry

Funding Source(s) and % Share: Transportation Development Centre, (47%)/Department of Supply and Services, (30%)/ National Energy Program, (35%)

Consultants/Contractors Used: UTDC Research & Development

Total Project Cost: (all years) $48,000 Total Project Cost: (1983 only) $2,000

Start Date: March 8, 1983 Completion Date: June 30, 1983

Project Manager: L. Suen, (514) 283-4100

Dissemination of Results: Limited number of copies available from TDC

Project Objective, Scope, Background, and Methodology:

To investigate the technical and market feasibility of the SailRail system through application of a linear induction motor. The work would include a market review to develop the general operating requirements of specific market segments; and a design study to determine preliminary system configurations and general operating scenario, including order of magnitude cost estimates. Should this study identify a favourable market, a demonstration syste will be developed for inauguration at Expo 86, a world transportation and related communications exhibit to be held in Vancouver.

Project Results/Conclusions/Preliminary Findings:

Information accumulated to date clearly indicates that the powered system is both technically feasible and economically attractive. On the basis of these findings, TDC is preparing a project for a demonstration system.

Further Research Work Identified:

Prototype development for SailRail system is underway at UTDC.

Project Number:	84
Subject:	Vehicle/System Market Research
Submitted by:	Transportation Development Centre

Project Title:	Transit Vehicle for the Disabled		
Title of Report:	Transit Vehicle for the Disabled - Phase II: Market Assessment		
Funding Source(s) and % Share:	Transportation Development Centre, (100%)		
Consultants/Contractors Used:	DelCan		
Total Project Cost: (all years)	$5,000	Total Project Cost: (1983 only)	-
Start Date:	February 1982	Completion Date:	October 1982
Project Manager:	L. Suen, (514) 283-4100		
Dissemination of Results:	Limited number of copies available from the Transportation Development Centre and the Canadian Urban Transit Association		

Project Objective, Scope, Background, and Methodology:

Phase II involved an evaluation of the market assessment for the "ideal" vehicle identified in Phase I "Definition of Requirements". The market evaluation for an ideal vehicle included a market assessment by survey, a preliminary estimate of market feasibility, and an estimation of vehicle requirements based on demographics. For the market assessment, a questionnaire was distributed to operators of services for the handicapped across Canada. The purpose was the collection of data on operating conditions, and vehicle requirements, thereby enabling a preliminary estimate of demand to be made for a ideal vehicle. Based on these results combined with estimated U.S. demand, a preliminary estimate of market feasibility was developed.

Project Results/Conclusions/Preliminary Findings:

The potential demand for a "$60,000 vehicle", in the next five years (years 1 - 5) is 190-275, and the potential demand in years 6 - 10 is approximately 96. Consequently, an average annual demand of 38 to 55 vehicles may exist in years 1 - 5 and about 20 vehicles per year in the following five years, for an annual average demand of between 29 and 37 over the ten year period. Demand for the vehicle in the United States is estimated at up to 150 vehicles per year in the near term. Responses from potential manufacturers indicate that a market size as estimated is insufficient to warrant establishment of the required production infrastructure. However, a Canadian manufacturer is currently developing a multi-purpose small bus with many of the desirable features of an ideal bus. It was decided to proceed with the development of functional specifications (to assist transit operators in tendering) rather than design specifications (to assist manufacturers in vehicle development).

Further Research Work Identified:

Proceed to Phase III - Specification Guidelines

Project Number: 85
Subject: Vehicle/System Market Research
Submitted by: Transportation Development Centre

Project Title: Disabled Group Transportation Vehicle

Title of Report: Disabled Group Transportation Vehicle

Funding Source(s) and % Share: Transportation Development Centre, (100%)

Consultants/Contractors Used: De Leuw Cather, Canada Ltd.

Total Project Cost: (all years) $30,000 Total Project Cost: (1983 only) $28,000

Start Date: November 30, 1982 Completion Date: March 31, 1983

Project Manager: R. Heron, (514) 283-4100

Dissemination of Results: Limited number of copies available from Transportation Development Centre

Project Objective, Scope, Background, and Methodology:

To determine the extent of national user demand for a vehicle whose technological features meet the specialized transportation requirements of large groups of disabled, especially those who are institutionalized, and to establish performance requirements and possible sources of funding for such a vehicle. A questionnaire was developed and mailed to a number of institutions across Canada, in order to determine (i) present travel and recreational patterns of potential user groups (ii) the types, availability and suitability of vehicles now in use and (iii) the perceived performance requirements of a vehicle with ideal technological attributes.

Project Results/Conclusions/Preliminary Findings:

The data are now being examined. Preliminary results indicate that a real need for such a vehicle exists. Average capacity would be about 15-17 passengers. A couple of configurations are being conceptualized. No report as yet.

Further Research Work Identified:

Project Number: 86
Subject: Construction Techniques
Submitted by: Stelco Inc.

Project Title: CSICC Industry Research Project #575

Title of Report: Steel Box Girders for Rapid Transit

Funding Source(s) and % Share: CSICC Membership

Consultants/Contractors Used: Read Harris Engineering

Total Project Cost: (all years) -

Total Project Cost: (1983 only) -

Start Date: -

Completion Date: -

Project Manager: F. Barker, (416) 528-2511

Dissemination of Results: To CISC membership and consultants involved in transit guideway design

Project Objective, Scope, Background, and Methodology:

To assess the feasibility of using steel or composite steel/concrete structures (beams and columns) for supporting rapid transit systems.

Project Results/Conclusions/Preliminary Findings:

The consultant developed a number of design and construction alternatives for transit guideways to enable the development of an economical steel design. At that time, it was hoped that an actual steel elevated structure could be incorporated into the government sponsored UTDC test facility. However, to date, no test guideway has been installed. However, the testing of the Panazader steel transit guideway at McMaster University was carried out.

Further Research Work Identified:

Project Number: 87
Subject: Construction Techniques
Submitted by: Stelco Inc.

Project Title: Guideway Design

Title of Report: Steel Structures for Mass Transit

Funding Source(s) and % Share: AISI Committee of Structural Steel Producers and the Committee of Steel Plate Producers (Members)

Consultants/Contractors Used: Sverdrup and Parcel and Associates Inc.

Total Project Cost: (all years) -
Total Project Cost: (1983 only) -

Start Date: -
Completion Date: -

Project Manager: A. Clauser and B. Spinner, (416) 528-2511

Dissemination of Results: All AISI Committee members publications used in the promotion to Rapid Transit Guideway Designers, copies available from AISI and CISC

Project Objective, Scope, Background, and Methodology:

To prepare a reference on the various facets of elevated guideway design and construction to enable the designer to gain an appreciation of the many considerations involved in guideway design.

Project Results/Conclusions/Preliminary Findings:

The Committee has provided the transit industry with a valuable reference document showing the use of steel in guideway construction to be a viable design solution.

Further Research Work Identified:

The reluctance of the rapid transit design office to use steel/concrete guideways even though studies have shown the negative concerns to be not valid (Hamilton-Wentworth Steel Alternate Guideway Study 1982) indicate that a research program directed at these concerns, sound vibration and appearance, should be initiated at a facility such as the Kingston UTDC test site.

Project Number: 88
Subject: Construction Techniques
Submitted by: City of Edmonton/Edmonton Transit

Project Title:	Rubber Grade Crossing System		
Title of Report:	Status Report for Rubber Crossing System		
Funding Source(s) and % Share:	Transportation Development Centre, (50%)/City of Edmonton, (50%)		
Consultants/Contractors Used:	None		
Total Project Cost: (all years)	$689.70	Total Project Cost: (1983 only)	$438.90
Start Date:	October 24, 1982	Completion Date:	August 9, 1983
Project Manager:	John Nicoll, Director of Plant and Electrical Systems		
Dissemination of Results:	To CUTA members		

Project Objective, Scope, Background, and Methodology:

The objectives are to test a grade crossing system which will improve the track circuit voltage and eliminate the necessity of frequent readjustments due to the changes of weather conditions; to test a grade crossing system which can protect and extend the life of subgrade at the crossings. The S-B track at 120 Avenue crossing was replaced with Parko grade crossing system and the N-B track was installed with conventional concrete block crossing system. Voltapes from both track circuits were recorded and compared on a weekly basis along with the weather conditions.

Project Results/Conclusions/Preliminary Findings:

Based on the results obtained, the rubber-grade crossing has provided much more stable track circuit readings and required only one adjustment throughout the whole test period as compared to three adjustments on the conventional concrete slab system. This also gave an indication on how well the crossing has been sealed from moisture and contamination which are ultimately responsible for the deterioration of subgrade and ballast.

Further Research Work Identified:

None

SERVICE AND METHODS

DEMONSTRATION

Project Number:	89		
Subject:	Transportation Services for the Disabled and Elderly		
Submitted by:	Vapor Canada Inc.		

Project Title:	Step and Lift Mechanism		
Title of Report:	Step and Lift Mechanism		
Funding Source(s) and % Share:	Vapor Canada Inc., (70%)/VIA Rail, (30%)		
Consultants/Contractors Used:	Various Design Consultants including Consultants for the Handicapped		
Total Project Cost: (all years)	$300,000	Total Project Cost: (1983 only)	$50,000
Start Date:	March 1981	Completion Date:	July 1984
Project Manager:	R. Khavarnejad, (514) 342-3210		
Dissemination of Results:	Restricted: Internal and VIA Rail		

Project Objective, Scope, Background, and Methodology:

There is a distinct need for a means to help the disabled passengers board/de-board a transit intercity car when its floor is higher than the station platform floor. Existing cars have no provisions. Also some of the older cars have inadequate entrance for normal passengers. Objective is to develop a system which (a) would carry a wheelchaired passenger into or out of a car, and (b) provide a staircase for normal passengers. Under a contract with a major National carrier, the product specification was developed, followed by design, prototype manufacturing, and testing of small number of units. In the design, a major restriction was placed so that this product would be applied on to the existing rolling stock without a need for altering the structural members. Functional requirements for design, development, and operations were evaluated by discussion with Transit Authority. Performance of this product was measured by manufacturing proper hardware and testing.

Project Results/Conclusions/Preliminary Findings:

The prototypes were tested under various conditions including equipping one car used in service daily. Test results obtained so far indicate the suitability of this product in its intended environment. A survey was also undertaken to determine passengers - both normal and handicapped - acceptance and the results were very satisfactory. The operating and maintenance crew also indicated their acceptance.

Further Research Work Identified:

Some refinements in controls at a future date; not yet determined.

Project Number: 90
Subject: Transportation Services for the Disabled and Elderly
Submitted by: Transportation Development Centre

Project Title: Field Evaluation of Hand Controls

Title of Report: None

Funding Source(s) and % Share: Transportation Development Centre, (100%)

Consultants/Contractors Used: W.R. Davis Engineering Limited

Total Project Cost: (all years) $15,000 | Total Project Cost: (1983 only) $15,000

Start Date: March 5, 1983 | Completion Date: November 1, 1983

Project Manager: R. Heron, (514) 283-4100

Dissemination of Results: -

Project Objective, Scope, Background, and Methodology:

To evaluate the quick-release hand control device developed by TDC, under field conditions, in terms of economic suitability for both the disabled user and the rental concessionaire. The disabled driver population will be limited to those having a valid driver's permit with the appropriate hand-control restriction, full use of both hands, and ability to use a left-handed control unit. At least three concessionnaires (two in Ottawa and one in St John's, Newfoundland) will be involved, each having at least two sets of hand controls available for installation. Data will be gathered over an approximate five-month period which includes summer months when heaviest use would be expected.

Project Results/Conclusions/Preliminary Findings:

Preliminary Findings: Not enough data was collected as field tests were not conducted in time to take advantage of a full summer's exposure. The field testing period is being extended over the summer of months when heaviest use would be expected.

Further Research Work Identified:

Project Number:	91
Subject:	Paratransit
Submitted by:	Alberta Transportation

Project Title:	Shared-Ride Taxi Demonstration Project		
Title of Report:	Shared-Ride Taxi-Transit Service: System Design		
Funding Source(s) and % Share:	Alberta Transportation, (100%)		
Consultants/Contractors Used:	GCG Engineering Partnership		
Total Project Cost: (all years)	$16,500	Total Project Cost: (1983 only)	$16,500
Start Date:	June 1983	Completion Date:	September 1983
Project Manager:	N/A		
Dissemination of Results:	For department use and general disbursement as requested		

Project Objective, Scope, Background, and Methodology:

Alberta Transportation is specifically interested in investigating alternative cost-effective approaches to the provision of transit service. Objectives of this study were to: 1) Identify and evaluate alternative taxi-transit service options; 2) Prepare a system design for the recommended service option; and, 3) Prepare a draft contract which could be used as a basis for negotiation with the taxi operator. Fort Saskatchewan expressed interest as they already had a taxi-transit service in operation for seniors and disabled.

Project Results/Conclusions/Preliminary Findings:

A recommended system was developed; a system was designed including recommended hours of service, fare structure etc. The actual demonstration project has been put on hold pending budget decisions.

Further Research Work Identified:

Possible further work upon completion of demonstration phase.

Project Number: 92
Subject: Paratransit
Submitted by: Damas & Smith Ltd.

Project Title: Ottawa Core Area Transportation System Mini-Bus Shuttle Bus

Title of Report: Ottawa Core Area Transportation System Mini-Bus Shuttle Bus

Funding Source(s) and % Share: National Capital Commission, (100%)

Consultants/Contractors Used: Damas & Smith, A Division of DSL Consultants Ltd.

Total Project Cost: (all years) $10,000
Total Project Cost: (1983 only) $10,000

Start Date: March 1, 1983
Completion Date: April 30, 1983

Project Manager: X.V. Fernandez, (416) 491-0111

Dissemination of Results: Report to the National Capital Commission

Project Objective, Scope, Background, and Methodology:

Follow up to previous study which examined various existing and proposed transportation systems which could provide a shuttle service. The study examined systems for a long term shuttle system as well as for a trial service in the summer of 1984. The study involved two parts: (I) Operating Systems (a) develop service characteristics (b) examine other shuttle systems (c) define system objectives and priorities (d) develop alternative operating options and recommendations. (II) Vehicles (a) examine available small buses (b) determine selection criteria (c) select vehicle characteristics and recommendations.

Project Results/Conclusions/Preliminary Findings:

Optimum bus size is 25 seats. Operation - 105 days (May - September) 8 hours/day. Vehicles - three existing vehicles were found to be suitable: (1) Orion II (2) Chance RT-50 (3) Trackless Trolley Fourth option - develop a prototype vehicle based on the Ginkelvan.

Further Research Work Identified:

Possibility of developing a new vehicle ideally suited for the role of a downtown shuttle service, based on the Ginkelvan prototype.

Project Number: 93
Subject: Paratransit
Submitted by: Transportation Development Centre

Project Title: Shared Vehicle Fleet Concept

Title of Report: Shared Vehicle Fleet Concepts: State-of-the-Art Review and R & D Definition

Funding Source(s) and % Share: National Energy Program, (100%)

Consultants/Contractors Used: Jouko A. Parviainen & Assoc.

Total Project Cost: (all years) $14,900 Total Project Cost: (1983 only) Nil

Start Date: August 6, 1982 Completion Date: March 31, 1983

Project Manager: L. Suen, (514) 283-4100

Dissemination of Results: Limited number of copies available from sponsoring agency on request

Project Objective, Scope, Background, and Methodology:

To conserve energy in the urban passenger transportation sector. To reduce fuel consumption by improved matching of vehicle attributes to travel needs utilizing shared fleets.

Project Results/Conclusions/Preliminary Findings:

This report recommends a six-step program for demonstration the feasibility of implementing shared vehicle fleet operations in Canada.

Further Research Work Identified:

Continuous monitoring of state-of-the-art and investigation into institutional issues.

Project Number: 94
Subject: Reserved Bus Lanes/Transit Priorities
Submitted by: Department of Roads and Traffic - Metropolitain Toronto

Project Title: Rules of the Road Demonstration Program

Title of Report: Transit Based Pre-Emptive Traffic Control Signals

Funding Source(s) and % Share: Ontario Ministry of Transportation and Communications, (100%)

Consultants/Contractors Used: N/A

Total Project Cost: (all years) $135,000 Total Project Cost: (1983 only) $$33,933

Start Date: August 1981 Completion Date: February 1983

Project Manager: D. Juneja, Transit Office, MTC, (416) 248-3785

Dissemination of Results: Report submitted to Metro Toronto Technical Transportation Planning Committee. Distributed to Ontario properties. Copies available from Transit Office, MTC.

Project Objective, Scope, Background, and Methodology:

In January 1980, Metro Toronto Council approved the staff report "Transit in the 1980's, A New Direction", recommending a higher priority for transit vehicles on the road system. Transit planners indicated that significant reductions in total travel time on transit vehicles could be attained if the amount of time spent waiting for a gap in traffic flow could be decreased. As a result, MTC, TTC, and Metro Toronto Roads and Traffic Department undertook a demonstration test of transit priority signals at the Yonge Street egress to the Eglinton TTC station. Data was collected on average queue, velocity, delay, passenger loading, vehicular volume, and travel time for all vehicles before the installation and again after the installation. (Installation Date: February 25, 1982)

Project Results/Conclusions/Preliminary Findings:

With instantaneous pre-emption, overall passenger delay time for transit and automobile traffic combined was reduced 53% from pre-signalized conditions. Optimum results were obtained by using instantaneous pre-emption in AM rush period and Fixed Cycle/Semi-Activation during all other time periods. The transit based priority signal at Eglinton Station are being retained on a permanent basis.

Further Research Work Identified:

Development of installation warrants for transit-based priority signals. Further investigations of integration of transit-based priority signals on a progression signal plan.

Project Number:	95
Subject:	Reserved Bus Lanes/Transit Priorities
Submitted by:	Department of Roads and Traffic - Metro/Toronto Transit Commission

Project Title:	Queen Street Transit Priority Measures		
Title of Report:	An Examination of Main-Line Transit Priority Measures for Metropolitan Toronto - Phase I and II		
Funding Source(s) and % Share:	Toronto Transit Commission/Metro Roads and Traffic Department, (100%)		
Consultants/Contractors Used:	None		
Total Project Cost: (all years)	$125,000	Total Project Cost: (1983 only)	-
Start Date:	November 1983	Completion Date:	November 1984
Project Manager:	P. Wenning, (416) 534-9511		
Dissemination of Results:	Report to be submitted to Metro Toronto Technical Transportation Planning Committee and City of Toronto Council		

Project Objective, Scope, Background, and Methodology:

The Toronto Transit Commission has identified Traffic Control Signal Stopped Time as comprising 10 - 20% of total elapsed trip time. The objectives of this project are to improve the efficiency and quality of transit service afforded transit patrons on the Queen Street streetcar line and to improve the total person - movement function of the arterial street, as a whole. The improvements in transit performance will be assessed relative to the overall movement in the study corridor, for all modes of transport. Before and after data collection include vehicular queue, delay, velocity, volume for transit and non-transit vehicles, loading/unloading time, transit passenger loading, actual headways.

Project Results/Conclusions/Preliminary Findings:

Not yet available.

Further Research Work Identified:

Project Number: 96
Subject: Reserved Bus Lanes/Transit Priorities
Submitted by: Toronto Transit Commission

- -

Project Title: Rule of the Road Campaign

Title of Report: Rules of the Road Evaluation Report

Funding Source(s) and % Share: Ontario Ministry of Transportation and Communications, (75%)/Toronto Transit Commission, (25%)

Consultants/Contractors Used: Environics Research Group

Total Project Cost: (all years) $340,000
Total Project Cost: (1983 only) -

Start Date: 1981
Completion Date: 1983

Project Manager: A.J. Gallo, (416) 481-4252

Dissemination of Results: -

- -

Project Objective, Scope, Background, and Methodology:

In January 1980, a TTC report expressed an interest in exploring ways to give TTC vehicles greater priority on the roads through a variety of policies. It was anticipated that increased priority for transit would result in reduced delays, reduced travel times, and improved reliability of service, thereby strengthening the role of transit as a benefit for the community. The Ministry of Transportation and Communications was not prepared to introduce legislative changes involving right-of-way rules and instead requested the TTC to first explore what could be achieved through a media program designed to encourage auto drivers to voluntarily give way to allow transit vehicles to enter traffic. In response to the request by MTC, a communication program was launched in September 1981 via radio, newsprint, and bus boards. The overall direction of the campaign was to establish the potential benefits of voluntary cooperation for all road users. The effectiveness of the campaign in achieving its objectives was evaluated by a research program consisting of surveys of Metro car drivers, TTC operators, and passengers, and an analysis of delays on selected routes and at intersections throughout Metro.

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Project Results/Conclusions/Preliminary Findings:

The campaign was judged to be a modest success. Analysis indicated that the program has influenced drivers to yield the right-of-way to buses leaving bus bays, but less positive results were observed with regard to turning at intersections.

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Further Research Work Identified:

Work is currently under way to develop a standard message with graphics that can be permanently placed on the rear of buses at streetcars as a reminder to other road users.

Project Number: 97
Subject: Reserved Bus Lanes/Transit Priorities
Submitted by: Laval Transit Commission

Project Title: Transfer Centres and Accelerated Bus Routes

Title of Report: Express Lines and "Incentive" Parks

Funding Source(s) and % Share: Laval Transit Commission, (100%)

Consultants/Contractors Used: None

Total Project Cost: (all years) -   Total Project Cost: (1983 only) -

Start Date: -   Completion Date: -

Project Manager: Laval Transit Commission

Dissemination of Results: -

Project Objective, Scope, Background, and Methodology:

Analysis of the potential to establish, in Laval, an express bus route and incentive parks.

Project Results/Conclusions/Preliminary Findings:

Several routes have a potential for establishing express service during peak hours. However, incentive parks, served by an express route, are currently not practical.

Further Research Work Identified:

Numéro du Projet 97
Sujet: Reserved Bus Lanes/Transit Priorities
Soumis par: Commission de transport de la Ville de Laval

Titre du projet: Carrefours de correspondance et parcours de véhicule accéléré

Titre du rapport: Lignes rapides et parc d'incitation

Source de financement et pourcentage des coûts défrayés par chaque organisme: Commission de transport de la Ville de Laval, (100%)

Consultants/Sous-traitants: Aucun

Coût total: (toutes les années) -

Coût total du projet: (1983 seulement) -

Le projet débute le: -

Fin du projet: Mai 1983

Directeur du projet: -

Dissémination des résultats: -

But, étendue, antécédents et méthodologie du projet:

Analyse de la potentialité d'implantation à Laval de parcours d'autobus à vitesse accélérée et de parcs d'incitation.

Résultats/Conclusions/Résultats préliminaires:

Plusieurs lignes ont un potentiel d'application pour des véhicules accélérés en période de pointe. Toutefois, un parc d'incitation desservi par une ligne expresse n'apparait pas viable actuellement.

Travail de recherche additionnel identifié:

Project Number: 98
Subject: Reserved Bus Lanes/Transit Priorities
Submitted by: City of Calgary/Calgary Transit

Project Title: Bus Only Lane Evaluation

Title of Report: Bus Only Lanes - Calgary

Funding Source(s) and % Share: City of Calgary, (67%)/Province of Alberta, (33%)

Consultants/Contractors Used: None

Total Project Cost: (all years) $15,000

Total Project Cost: (1983 only) $6,300

Start Date: January 1983

Completion Date: June 1984

Project Manager: D. Bolger, City of Calgary, Transportation Department, (403) 268-1631

Dissemination of Results: Affected civic departments and provincial government; limited number of copies available for other interested parties

Project Objective, Scope, Background, and Methodology:

To determine the viability of "Bus Only" Lanes (contra-flow, with-flow, full-time, part-time) on selected roadways (primarily downtown) within the City of Calgary. A small group of candidate locations will be selected on the basis of discussions with key departments (Police, Transit, Traffic) and review of existing operating data. These locations will then be thoroughly investigated for the possible implementation of bus only lane using a series of examination criteria.

Project Results/Conclusions/Preliminary Findings:

None to date (action on project was temporarily deferred pending results of related studies).

Further Research Work Identified:

Project Number:	99		
Subject:	Reserved Bus Lanes/Transit Priorities		
Submitted by:	Quebec Ministry of Transport		
Project Title:	Reserved Bus Lanes		
Title of Report:	-		
Funding Source(s) and % Share:	Quebec Ministry of Transport, (100%)		
Consultants/Contractors Used:	Canatrans Consulting/Transurb Inc.		
Total Project Cost: (1983 - 1984)	$170,000	Total Project Cost: (1983 only)	$51,000
Start Date:	1979	Completion Date:	-
Project Manager:	Nguyen Quang Quy, (418) 643-1675		
Dissemination of Results:	-		

Project Objective, Scope, Background, and Methodology:

To make bus service more efficient and more economical, urban transit should benefit, in some critical areas, of special rights in using routes. Municipalities must be advised of the economical advantages to incite them to go ahead with such plans.

Project Results/Conclusions/Preliminary Findings:

The success of the Champlain Bridge demonstration has incited the CTL to try the same on the Laurentides Boulevard. Results are good. They are currently considering measures on the Mercier Bridge and in downtown Montreal.

Further Research Work Identified:

Would like to build a model of the demand for reserved lanes.

Numéro du Projet	99
Sujet:	Reserved Bus Lanes/Transit Priorities
Soumis par:	Ministère des Transports du Québec

- -

Titre du projet:	Voies réservées		
Titre du rapport:	-		
Source de financement et pourcentage des coûts défrayés par chaque organisme:	Ministère des Transports du Québec, (100%)		
Consultants/Sous-traitants:	Canatrans/Transurb		
Coût total: (1983-1984)	$170,000	Coût total du projet: (1983 seulement)	$51,000
Le projet débute le:	1979	Fin du projet:	-
Directeur du projet:	Nguyen Quang Quy, (418) 643-1675		
Dissémination des résultats:	-		

- -

But, étendue, antécédents et méthodologie du projet:

En vue de rendre le service autobus plus efficace et plus économique, il doit pouvoir bénéficier, à certains points critiques, de droits spéciaux d'utilisation de la voirie. Les autorités municipales doivent être informées des avantages économiques pour les inciter à aller de l'avant.

- -

Résultats/Conclusions/Résultats préliminaires:

Le succès de la démonstration sur le pont Champlain a incité la CTL à tenter l'expérience sur le boulevard des Laurentides. Les résultats sont bons. On songe à des mesures au centre-ville de Montréal et sur le pont Mercier.

- -

Travail de recherche additionnel identifié:

On veut construire un modèle de demande pour les voies réservées.

Project Number: 100
Subject: Reserved Bus Lanes/Transit Priorities
Submitted by: Beauchemin Beaton Lapointe Inc.

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Project Title:	Study of Urban Transit in the Laurentide Boulevard Corridor		
Title of Report:	Final Report of the Study of Urban Transit in the Laurentide Boulevard Corridor		
Funding Source(s) and % Share:	Quebec Ministry of Transport, (100%)		
Consultants/Contractors Used:	Beauchemin-Beaton-Lapointe Inc.		
Total Project Cost: (all years)	$75,000	Total Project Cost: (1983 only)	$30,000
Start Date:	January 1982	Completion Date:	February 1984
Project Manager:	Robert Kahle		
Dissemination of Results:	CTL, City of Laval, City of Montreal, COTREM		

- -

Project Objective, Scope, Background, and Methodology:

Congestion in the Laurentide Boulevard Axis, the major access route of Laval to the subway station, was creating operating inefficiencies in the bus service and rider dissatisfaction. The bridge prevents short term increase in the capacity of the corridor. This goal of the study was to develop a set of preferential treatment measures for buses, to implement them, and to measure their efficiency. The study included an inventory of the capacity of infrastructure, analysis of preferential treatment strategies, etc.

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Project Results/Conclusions/Preliminary Findings:

Following the adjustments and the implementation of preferential treatment, there was a clear reduction in the route length (time - wise), and an improvement in service regularity. Based on the results, the corridor has been extended too close to the subway station.

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Further Research Work Identified:

There is a need for normalizing signalling devices. It would be interesting and useful to develop justification criteria for preferential treatment measures (reserved lanes, priority at intersections, etc.)

Numéro du Projet 100
Sujet: Reserved Bus Lanes/Transit Priorities
Soumis par: Beauchemin Beaton Lapointe Inc.

- -

Titre du projet:	Étude des transports en commun dans le corridor du boulevard des Laurentides		
Titre du rapport:	Rapport final sur l'étude des transports en commun dans le corridor du boulevard des Laurentides		
Source de financement et pourcentage des coûts défrayés par chaque organisme:	Ministère des Transports du Québec, (100%)		
Consultants/Sous-traitants:	Beauchemin-Beaton-Lapointe Inc.		
Coût total: (toutes les années)	$75,000	Coût total du projet: (1983 seulement)	$30,000
Le projet débute le:	Janvier 1982	Fin du projet:	Février 1984
Directeur du projet:	Robert Kahle		
Dissémination des résultats:	Commission de transport de Laval, Ville de Laval, Ville de Montréal, COTREM		

- -

But, étendue, antécédents et méthodologie du projet:

La congestion dans l'axe du boulevard des Laurentides, la principale voie d'accès de Laval au terminus du métro, occasionnait des inefficacités d'exploitation du service d'autobus et de l'insatisfaction de la part des usagers. La présence d'un pont dans le corridor empêche à court terme l'accroissement de la capacité du réseau routier. L'objectif était donc de concevoir un ensemble de mesures de traitement préférentiel des autobus, d'en préparer la mise en place et d'en vérifier l'efficacité. Le projet comprenait un inventaire de l'occupation du sol et de la capacité des infrastructures dans le corridor à l'étude, une analyse des stratégies de traitement préférentiel, une recherche et une évaluation des techniques et des dispositifs utilisables dans le contexte du projet, la préparation des concepts détaillés et subséquemment l'évaluation de l'impact des mesures mises en place sur l'efficacité du service d'autobus.

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Résultats/Conclusions/Résultats préliminaires:

Suite aux aménagements et à la mise en place des mesures de traitement préférentiel des autobus, il y a eu une nette diminution des temps de parcours et une amélioration sensible de la régularité du service. Compte tenu des résultats, le corridor a été prolongé jusqu'aux abords du terminus du métro.

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Travail de recherche additionnel identifié:

Il y a un besoin de normaliser les dispositifs de signalisation. Il serait intéressant et utile de développer des critères de justification de mesures de traitement préférentiel (voie réservée, priorité aux carrefours, etc.)

Project Number:	101
Subject:	Reserved Bus Lanes/Transit Priorities
Submitted by:	Laval Transit Commission

Project Title:	Reserved Bus Lanes		
Title of Report:	Evaluation of Bus Service Circulation in Exclusive Lanes of the Laurentides Boulevard		
Funding Source(s) and % Share:	Laval Transit Commission		
Consultants/Contractors Used:	None		
Total Project Cost: (all years)	-	Total Project Cost: (1983 only)	-
Start Date:	October 1982	Completion Date:	October 1983
Project Manager:	COTREM		
Dissemination of Results:	-		

Project Objective, Scope, Background, and Methodology:

To review the recommendations proposed in previous studies regarding the designation of a reserved lane for CTL buses. Present results of priority measures. Recommend a methodology to ensure the continuity (continuation) of the experience. To evaluate future possibilities of developing measures for priorities favouring bus circulation on this axis.

Project Results/Conclusions/Preliminary Findings:

Priority measures on the Laurentides Boulevard, bring a definite improvement in regularity, a shorter route length for buses. They have no negative effect on circulation, in general, on security, on maintenance, or on houses along the route.

Further Research Work Identified:

Numéro du Projet	101
Sujet:	Reserved Bus Lanes/Transit Priorities
Soumis par:	Commission de transport de la Ville de Laval

- -

Titre du projet:	Voie réservé		
Titre du rapport:	Évaluation du service d'autobus circulant dans les voies exclusives du boulevard des Laurentides		
Source de financement et pourcentage des coûts défrayés par chaque organisme:	Commission de transport de la Ville de Laval, (100%)		
Consultants/Sous-traitants:	Aucune		
Coût total: (toutes les années)	-	Coût total du projet: (1983 seulement)	-
Le projet débute le:	Octobre 1982	Fin du projet:	Octobre 1983
Directeur du projet:	COTREM		
Dissémination des résultats:	-		

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But, étendue, antécédents et méthodologie du projet:

Réevaluer les recommandations proposées dans les études antérieures concernant l'instauration de voie réservée pour les autobus de la CTL. Présenter les résultats des mesures prioritaires. Proposer une méthodologie afin d'assurer le suivi de l'expérience. Évaluer les possibilités futures de développement des mesures prioritaires favorisant la circulation des autobus sur cet axe.

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Résultats/Conclusions/Résultats préliminaires:

Les mesures prioritaires sur le boulevard des Laurentides apportent une amélioration sensible de la régularité, une diminution de temps de parcours pour les autobus. Elles n'ont pas d'effet négatif sur la circulation générale, la sécurité, l'entretien et les riverains. La perception des usagers face à ces mesures est positive.

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Travail de recherche additionnel identifié:

Project Number:	102
Subject:	Reserved Bus Lanes/Transit Priorities
Submitted by:	Beauchemin Beaton Lapointe Inc.

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Project Title:	Reserved Bus Lanes		
Title of Report:	Phase II of the Reserved Lane on Laurentides Boulevard		
Funding Source(s) and % Share:	Laval Transit Commission, (100%)		
Consultants/Contractors Used:	Beauchemin-Beaton-Lapointe Inc.		
Total Project Cost: (all years)	$24,200	Total Project Cost: (1983 only)	-
Start Date:	-	Completion Date:	February 1983
Project Manager:	Laval Transit Commission		
Dissemination of Results:	-		

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Project Objective, Scope, Background, and Methodology:

Analysis of the various alternatives to extend the reserved bus lane, on the Laurentides Boulevard in Laval, up to the new CTL terminal in Montreal.

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Project Results/Conclusions/Preliminary Findings:

Three scenarios were proposed based on short term, medium term, and long term implementation strategies.

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Further Research Work Identified:

Numéro du Projet	102
Sujet:	Reserved Bus Lanes/Transit Priorities
Soumis par:	Beauchemin Beaton Lapointe Inc.

Titre du projet:	Voie réservé		
Titre du rapport:	Phase II de la voie réservée sur le boulevard des Laurentides		
Source de financement et pourcentage des coûts défrayés par chaque organisme:	Commission de transport de la Ville de Laval, (100%)		
Consultants/Sous-traitants:	Beauchemin-Beaton-Lapointe Inc.		
Coût total: (toutes les années)	$24,200	Coût total du projet: (1983 seulement)	-
Le projet débute le:	-	Fin du projet:	Février 1983
Directeur du projet:	Commission de transport de la Ville de Laval		
Dissémination des résultats:	-		

But, étendue, antécédents et méthodologie du projet:

Analyser les diverses solutions à envisager pour prolonger la voie réservée aux autobus sur le boulevard des Laurentides à Laval jusqu'au nouveau terminus de la CTL à Montréal.

Résultats/Conclusions/Résultats préliminaires:

Proposition de trois (3) scénarios selon une stratégie d'implantation à court, moyen et long terme.

Travail de recherche additionnel identifié:

Project Number:	103
Subject:	Fare Collection/Fare Policies
Submitted by:	Ontario Ministry of Transportation and Communications

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Project Title:	Honour Fare (Proof of Payment)		
Title of Report:	Honour Fare - A Study of Practical Applications in Ontario		
Funding Source(s) and % Share:	Ontario Ministry of Transportation and Communications, (100%)		
Consultants/Contractors Used:	DeLCan		
Total Project Cost: (all years)	$199,600	Total Project Cost: (1983 only)	$146,000
Start Date:	March 1982	Completion Date:	July 1984
Project Manager:	D. Juneja, Transit Office, Ontario Ministry of Transportation and Communications, (416) 248-3785		
Dissemination of Results:	N/A		

Project Objective, Scope, Background, and Methodology:

The objective is to investigate the feasibility, operational benefits, and problems associated with the implementation of an honour fare system. An in-service demonstration in conjunction with articulated buses is presently under way in Ottawa to assess: (1) the changes in the on-street performance of the bus service; (2) the public acceptance; and, (3) the fraud levels associated with honour fare. OC Transpo is recording passenger loadings, dwell times and door usage patterns using their Automatic On-Bus data collection system. The "Before" and "After" data will be analyzed by DeLCan and a report will be produced.

Project Results/Conclusions/Preliminary Findings:

The preliminary findings indicate that the public acceptance is good and fraud levels are around 1% (based on security checks of about 3-4% of passengers per day). Final report available shortly.

Further Research Work Identified:

None

Project Number:	104
Subject:	Fare Collection/Fare Policies
Submitted by:	Ontario Ministry of Transportation and Communications/GO Transit

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Project Title: Proof of Payment Demonstration

Title of Report: Proof of Payment Demonstration on the Milton Rail Line

Funding Source(s) and % Share: GO Transit, (100%)

Consultants/Contractors Used: IBI Group

Total Project Cost: (all years) $350,000 Total Project Cost: (1983 only) $25,000

Start Date: December 1984 Completion Date: June 1985

Project Manager: R.D. Boyle, GO Transit, (416) 630-5220

Dissemination of Results: GO Transit, GO/ALRT

Project Objective, Scope, Background, and Methodology:

GO Transit has been involved for some time in assessing possible modifications to the existing fare collection system. A study of fare collection alternatives on the GO Transit Milton line recommended the implementation of a no-barrier self-service fare collection system on this line, including Union Station. If this system operates successfully on the Milton line, consideration will be given to extending it system-wide. Initially for the Milton line, there will be an attendant in each outlying station. The presence of the attendant would minimize the initial capital investment in fare vending equipment and would eliminate the need for remote surveillance in the outlying stations.

Project Results/Conclusions/Preliminary Findings:

Request for proposals detailing functional requirements, specifications, and contract terms for the supply and installation of the ticket issuing equipment had been let and proposals received. The proposals are being evaluated and the contract is expected to be awarded by the end of March 1984. The implementation date of the Milton line demonstration is targeted for December 1, 1984.

Further Research Work Identified:

To be determined.

Project Number:	105
Subject:	Fare Collection/Fare Policies
Submitted by:	Toronto Transit Commission

Project Title:	Honour Fare Study		
Title of Report:	Same as above		
Funding Source(s) and % Share:	Toronto Transit Commission, (100%)		
Consultants/Contractors Used:	None		
Total Project Cost: (all years)	$40,000	Total Project Cost: (1983 only)	-
Start Date:	1984	Completion Date:	1984
Project Manager:	J. Davies, Toronto Transit Commission, (416) 481-4252		
Dissemination of Results:	TTC Management/Commission		

Project Objective, Scope, Background, and Methodology:

In June 1982, an honour fare system was tentatively proposed for the Scarborough RT. An honour fare system was not implemented on the Scarborough line, instead it was decide to review the issue of honour fare on a system wide basis. The purpose of the study is to investigate the concept of honour fare, its operational feasibility and, its applicability to the TTC's system of routes. The study will include an assessment of the costs and benefits of implementing an honour fare system, the feasibility of a test program and an outline of an experimental application of honour fare.

Project Results/Conclusions/Preliminary Findings:

Study terms of reference have been determined. Work is currently underway.

Further Research Work Identified:

N/A

Project Number:	106		
Subject:	Fare Collection/Fare Policies		
Submitted by:	City of Edmonton/Edmonton Transit		
Project Title:	Identification & Evaluation of Fare Collection Equipment with Dollar Bill Acceptance		
Title of Report:	I) Identification & Evaluation of Dollar Bill Acceptance in Transit Fareboxes, II) Summary of Dollar Bill Problem in Transit's Fare Collection Systems		
Funding Source(s) and % Share:	Alberta Transportation, (66%)/City of Edmonton, (33%)		
Consultants/Contractors Used:	None		
Total Project Cost: (all years)	$10,000	Total Project Cost: (1983 only)	$5,000
Start Date:	November 1982	Completion Date:	January 1984
Project Manager:	Salim Keshwani, Projects Engineer		
Dissemination of Results:	By request to Transportation Department TMD - Transit Planning, City of Edmonton		

Project Objective, Scope, Background, and Methodology:

The objective of the study was to identify a secure, efficient, and effective means of accepting and handling dollar bills in transit's fare collection system. Increasing number of dollar bills are received by the fare collection system designed for handling coins, as the fare approaches a dollar. In some cases the fareboxes have jammed. An industry survey was undertaken to evaluate the extent of the problem and measures taken by other transit authorities. Also the potential of utilizing the new electronic fareboxes was examined. The option of modifying the existing Duncan Accept-fare fareboxes was examined and a prototype built. The options of using other fare media such as tickets, tokens, etc. were also examined.

Project Results/Conclusions/Preliminary Findings:

The electronic fareboxes are cost prohibitive. An existing Duncan farebox was modified by using air pressure jets to accept greater number of dollar bills. It was found that this box was capable of accepting up to 120 dollar bills. Once this was exceeded, the jamming problem reappeared. The optimum solution for the dollar bill problem in transit's fareboxes is to introduce a dollar coin instead of a dollar bill.

Further Research Work Identified:

Project Number: 107
Subject: Fare Collection/Fare Policies
Submitted by: Canadian Bank Note Company

Project Title: Transit Pass Security

Title of Report: Security Requirements for Transit Passes

Funding Source(s) and % Share: Canadian Bank Note Company Limited, (100%)

Consultants/Contractors Used: None

Total Project Cost: (all years) -
Total Project Cost: (1983 only) -

Start Date: January 1983
Completion Date: December 1984

Project Manager: Dr. K.E. Nixon, Director of Research, (613) 722-3421

Dissemination of Results: Canadian Associations

Project Objective, Scope, Background, and Methodology:

Functional and Security requirements of transit passes will be studied in order to define their essential characteristics. Methods of satisfying these requirements will be investigated and samples prepared. A recommendation for the specifications of security requirements will be made together with proposals for a cost effective solution to satisfying these requirements.

Project Results/Conclusions/Preliminary Findings:

Studies have generated a preliminary set of specifications and transit passes currently produced are being measured against these. Emphasis has been placed on: 1) Maximizing the ease with which a "hands-off" visual inspection enables genuine current passes to be distinguished from counterfeit or altered passes; and 2) Providing a simple and effective method by which a "hands-on" inspection discriminates a genuine from a counterfeit or altered pass.

Further Research Work Identified:

Continuing product/functional and security analysis to support future product development.

Project Number: 108

Subject: Fare Collection/Fare Policies

Submitted by: Canadian Urban Transit Association

Project Title: Monthly Passes - Questionnaires 83-9

Title of Report: Monthly Transit Passes - 1983 Experience

Funding Source(s) and % Share: Canadian Urban Transit Association, (100%)

Consultants/Contractors Used: None

Total Project Cost: (all years) -

Total Project Cost: (1983 only) -

Start Date: January 1984

Completion Date: April 1984

Project Manager: François Rivest, Canadian Urban Transit Association, (416) 365-9800

Dissemination of Results: Available from the Canadian Urban Transit Association

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Project Objective, Scope, Background, and Methodology:

Many transit systems are implementing a monthly pass for various fare categories. A wide range of formulas are used to estimate the number of rides per month and establish the price of the pass. The method used to calculate the number of rides per month can affect monthly ridership significantly. As well, the pricing of a monthly pass can have significant impacts on revenue generation. A questionnaire was distributed to all CUTA members to obtain information on the number of passes sold, the methods and surveys used to calculate usage and ridership figures and the formulas used to establish pass prices.

Project Results/Conclusions/Preliminary Findings:

Monthly pass sales in 1983 exceeded 8,000,000 representing on average 37.7% of total ridership for those systems who responded. Monthly pass sales are highest in October/November and lowest in July/August. The vast majority of passes sold are Adult passes priced at a certain multiple of the adult cash fare. In most cases this multiple is lower than the estimated/actual number of rides per month per pass. Even minor differences in the estimated and/or actual number of rides per month in comparison to the ridership formula can affect ridership figures significantly. This is true even when pass sales represent only 25 - 35% of total revenue passengers.

Further Research Work Identified:

Project Number: 109
Subject: Fare Collection/Fare Policies
Submitted by: St. John's Transportation Commission

Project Title:	Passes to University Students		
Title of Report:	The Feasibility of Providing Students Free Access to Public Transit		
Funding Source(s) and % Share:	St. John's Transportation Commission, (100%)		
Consultants/Contractors Used:	None		
Total Project Cost: (all years)	-	Total Project Cost: (1983 only)	-
Start Date:	January 1984	Completion Date:	February 1984
Project Manager:	J.L. Pitcher, (709) 722-9400		
Dissemination of Results:	Report presentation to members of the Commission		

Project Objective, Scope, Background, and Methodology:

To collect from the Student Union and/or University sufficient funds to reasonably cover the cost of providing free transportation service to present and future enrolled students at Memorial University.

Project Results/Conclusions/Preliminary Findings:

Investigations and analysis indicated that this system is not financially feasible or administratively practical.

Further Research Work Identified:

Nil

Project Number:	110
Subject:	Fare Collection/Fare Policies
Submitted by:	City of Calgary/Calgary Transit

Project Title:	Zipcard Study		
Title of Report:	1982 Zipcard Survey		
Funding Source(s) and % Share:	City of Calgary, (100%)		
Consultants/Contractors Used:	None		
Total Project Cost: (all years)	$3,000	Total Project Cost: (1983 only)	$1,000
Start Date:	June 1982	Completion Date:	August 1983
Project Manager:	D. Bolger, City of Calgary, Transportation Department, (403) 268-1631		
Dissemination of Results:	Internal use only		

Project Objective, Scope, Background, and Methodology:

A survey of 1400 zipcard (monthly transit pass) users was completed between June and November 1982 to determine usage characteristics.

Project Results/Conclusions/Preliminary Findings:

1) Zipcard is used an average of 53.5 trips per month. 2) 70% of zipcard riders have been using a zipcard for less than a year. 3) 87% of all zipcard trips are taken during weekdays, 13% evenings and weekends. 4) 23% of zipcard users lend their zipcards to other people.

Further Research Work Identified:

N/A

Project Number:	111
Subject:	Fare Collection/Fare Policies
Submitted by:	Standard Change Makers

Project Title:	Programmable Token Vendor		
Title of Report:	No report available		
Funding Source(s) and % Share:	Toronto Transit Commission, (100%)		
Consultants/Contractors Used:	Standard Change-Makers, Inc.		
Total Project Cost: (all years)	N/A	Total Project Cost: (1983 only)	N/A
Start Date:	January 1, 1983	Completion Date:	March 15, 1984
Project Manager:	Robert T. Bayne		
Dissemination of Results:	To the Toronto Transit Commission		

Project Objective, Scope, Background, and Methodology:

Project involved the development of a new token vending machine which will be used by the Toronto Transit Commission on the subway system. The machine is computer controlled and may be programmed as to price, number of tokens delivered, etc. by means of a keypad. The machine represents the latest state of the art in self-service fare collection.

Project Results/Conclusions/Preliminary Findings:

The entire 44 machines have been delivered and the first eight are working on line.

Further Research Work Identified:

Project Number:	112 .
Subject:	Fare Collection/Fare Policies
Submitted by:	Toronto Transit Commission

Project Title:	Magnetically Encoded Ticket System (MET)		
Title of Report:	MET - Operational Tests		
Funding Source(s) and % Share:	Ontario Ministry of Transportation and Communications, (75%)/Toronto Transit Commission, (25%)		
Consultants/Contractors Used:	None		
Total Project Cost: (all years)	$1,100,000	Total Project Cost: (1983 only)	-
Start Date:	1982	Completion Date:	1985
Project Manager:	D. Mair, (416) 481-4252		
Dissemination of Results:	Public report		

Project Objective, Scope, Background, and Methodology:

Current ticket and pass holders commonly are delayed when entering subway stations as they must pass the station collectors' booth. Line-ups at station collection booths due to information requests, fare transactions, etc. leads to unnecessary delays for passengers with pre-purchasing fares. The purpose of the projects to test magnetically encoded ticket vending equipment which handles both tickets and the monthly pass in order to assess its suitability for the TTC. The test will involve measurements and video surveillance of the test installations. 12 ticket machines and 5 pass machines have been installed for a 12 month test on the northbound side of the Yonge subway line at Yonge, College, Dundas, Queen, King, and Union Station. The test turnstiles will operate during rush hours only (6:00 - 9:30 am and 3:30 - 7:00 pm) Monday through Friday. The new turnstiles will not accept existing TTC tokens or tickets. A marketing campaign (be a "Stripes" Tester) has been launched to coincide with the beginning of the test period.

Project Results/Conclusions/Preliminary Findings:

Tests begin May 1, 1984. A report outlining the results of the test program and recommendations concerning full system implementing will be prepared on completion of the project.

Further Research Work Identified:

Project Number: 113
Subject: Articulated Buses
Submitted by: Ontario Ministry of Transportation and Communications/Toronto Transit Commission/ OC Transpo

Project Title: Articulated Bus

Title of Report: Articulated Bus - An In-Service Evaluation

Funding Source(s) and % Share: Ontario Ministry of Transportation and Communications, (100%)

Consultants/Contractors Used: None

Total Project Cost: (all years) $18,856,000
Total Project Cost: (1983 only) $695,000

Start Date: February 1977
Completion Date: October 1986

Project Manager: D. Juneja, Transit Office, Ontario Ministry of Transportation and Communications, (416) 248-3785

Dissemination of Results: N/A

Project Objective, Scope, Background, and Methodology:

The objective is to field test and evaluate articulated buses in service. The evaluation will include operations, performance capabilities, and cost saving potential of these buses. The participants (TTC, OC Transpo, Mississauga, HSR) will collect the cost and performance data. MTC and properties will jointly analyse this data and produce a final report at the end of the project. Phase I - the procurement state is complete. This phase included: 1) the preparation of specifications and procurement documents; 2) tendering, evaluation, and contract award; 3) delivery of vehicles - 53 GM artic buses were delivered to the four properties by the end of 1982. The project is now in Phase II - Testing and Data Collection. Data collection-driver attitudinal survey, passenger attitudinals survey, and data on operational economics. OC Transpo demonstration involves equipping 11 vehicles with automatic passenger counters.

Project Results/Conclusions/Preliminary Findings:

Preliminary results are encouraging. Public and driver attitude is favourable. Operational evaluation yet to be fully analyzed.

Further Research Work Identified:

Project Number: 114
Subject: Articulated Buses
Submitted by: Laval Transit Commission/Quebec Ministry of Transport

Project Title: Use of Articulated Buses

Title of Report: Potential for Using Articulated Buses at the CTL and CTRSM

Funding Source(s) and % Share: Quebec Ministry of Transport, (100%)

Consultants/Contractors Used: Canatrans Consulting/Transurb Inc.

Total Project Cost: (all years) $115,000 Total Project Cost: (1983 only) $54,000

Start Date: February 1983 Completion Date: July 1983

Project Manager: COTREM

Dissemination of Results: -

Project Objective, Scope, Background, and Methodology:

This study is part of a project to evaluate ways to use articulated buses for CTRSM and CTL. Objective is identify routes which are ideal for articulated buses and carry out a demonstration project for the benefit of all Quebec properties. The four phase study includes: I) operational feasibility studies (including the definition of requirements and objectives for the demonstration project); 2) the development of terms of reference to evaluate the results of the demonstration and collect the data required for a comparative analysis; 3) the operation of articulated buses for test purposes and; 4) evaluation and recommendations, Phase 4 will include the development of criteria which would help operating properties in studying possible uses of a mixed fleet of vehicles.

Project Results/Conclusions/Preliminary Findings:

It was recommended that CTL and CTRSM accept the demonstration project and test vehicles on several routes, that the province of Quebec, CTL, and CTRSM agree on a purchasing method and that the results be distributed to all Quebec properties. It was also recommended that a study group be established to develop purchasing guidelines cost-estimates, possibilities for leasing etc., and that an employee training program be developed without delay. A request has been made by CTL, CTCUQ, and CTRSM for the purchase of 25 buses.

Further Research Work Identified:

GM to conduct R & D beginning in 1987 (18 months). Before and after observations would be made.

Numéro du Projet 114
Sujet: Articulated Buses
Soumis par: Ministère des transports du Québec/Commission de transport de la Ville de Laval

Titre du projet: Autobus articulé

Titre du rapport: Potentiel d'utilisation de l'autobus articulé par la CTL et la CTRSM

Source de financement et pourcentage des coûts défrayés par chaque organisme: Ministère des transports du Québec, (100%)

Consultants/Sous-traitants: Canatrans/Transurb Inc.

Coût total: (toutes les années) $115,000 Coût total du projet: (1983 seulement) $54,000

Le projet débute le: Février 1983 Fin du projet: Juillet 1983

Directeur du projet: COTREM

Dissémination des résultats: -

But, étendue, antécédents et méthodologie du projet:

Il s'agit de vérifier la possibilité d'utiliser ce type de véhicule pour le régime d'exploitation québécois. Diverses questions ont été abordées, par exemple le mode de perception de billets ou les économies réalisables au niveau du personnel. L'étude a été menée en collaboration avec les commissions de transport.

Résultats/Conclusions/Résultats préliminaires:

Une demande a été adressée en vue de l'achat de 25 autobus pour la CTCUQ, la CTL et la CTRSM.

Travail de recherche additionnel identifié:

R & D technique par General Motors: la période d'expérimentation de 18 mois débuterait en 1987. Des relevés de la situation avant-après seraient entrepris.

Project Number: 115
Subject: Articulated Buses
Submitted by: Montreal Urban Transit Commission

Project Title: Articulated Bus

Title of Report: None

Funding Source(s) and % Share: MUCTC (100%)

Consultants/Contractors Used: None

Total Project Cost: (all years) -
Total Project Cost: (1983 only) -

Start Date: -
Completion Date: -

Project Manager: Pierre De Villers (514) 877-6079

Dissemination of Results:

Project Objective, Scope, Background, and Methodology:

No study was undertaken on the impacts of articulated buses from a maintenance perspective. MUCTC facilities are not designed to accommodate articulated buses. MUCTC will need reserved spaces with three-cylinder jacks or mobile jacks for maintenance. OC Transpo has already supplied information concerning their maintenance costs with articulated buses. A full study is now underway.

Project Results/Conclusions/Preliminary Findings:

No results available.

Further Research Work Identified:

Numéro du Projet	115
Sujet:	Articulated Buses
Soumis par:	Commission de transport de la Communauté urbaine de Montréal

Titre du projet:	Autobus articulé		
Titre du rapport:	Aucun		
Source de financement et pourcentage des coûts défrayés par chaque organisme:	CTCUM (100%)		
Consultants/Sous-traitants:	Aucun		
Coût total: (toutes les années)	-	Coût total du projet: (1983 seulement)	-
Le projet débute le:	-	Fin du projet:	-
Directeur du projet:	Pierre De Villers (514) 877-6079		
Dissémination des résultats:			

But, étendue, antécédents et méthodologie du projet:

Aucune étude ou travail concernant l'implication au niveau entretien ne fut réalisé sur ce sujet. Il est évident que nos installations ne sont pas habilitées à recevoir ce type de véhicules. Nos ateliers (incluant le garage St-Laurent) ont été conçus pour des autobus de 40 pieds. Il faudra sans doute réserver des espaces précis avec verins à trois cylindres ou vérins mobiles pour en effectuer l'entretien. On ne peut se référer qu'à "OC Transpo" qui a quelques véhicules de ce genre en essai depuis quelque temps. Cette entreprise a déjà avancé des chiffres comparatifs concernant les coûts d'entretien (ex: moteur, transmission, diesel, (consommation), etc.).

Résultats/Conclusions/Résultats préliminaires:

Résultats non disponibles.

Travail de recherche additionnel identifié:

Project Number:	116
Subject:	Articulated Buses
Submitted by:	Alberta Transportation

Project Title:	Articulated Bus Demonstration Project		
Title of Report:	Alberta Articulated Bus Demonstration Project		
Funding Source(s) and % Share:	Alberta Government: Departments of Transportation and Economic Development, (100%)		
Consultants/Contractors Used:	John Morrall/City of Edmonton, City of Calgary Transit Departments		
Total Project Cost: (all years)	$68,000	Total Project Cost: (1983 only)	$6,000
Start Date:	November 1982	Completion Date:	January 1983
Project Manager:	N/A		
Dissemination of Results:	Summary report available upon request		

Project Objective, Scope, Background, and Methodology:

The report is a documentation of a study to demonstrate the operational capabilities and to examine the economic feasibility of incorporating articulated buses into the transit systems of Edmonton and Calgary. Objectives are to identify the vehicles operational service characteristics, maintenance requirements, technical/mechanical performance characteristics, user and operator acceptance, and the cost-benefit implications of introducing articulated vehicles into the transit fleets of Edmonton and Calgary. For the demonstration project two M.A.N. buses and one Volvo bus were selected after on-site inspection. This report is a summation of the 2 year test period and recommendations as a result of the study are included.

Project Results/Conclusions/Preliminary Findings:

The demonstration project concluded that provided that future articulated buses incorporate all necessary modifications (as outlined in the report) to enable them to operate effectively in Edmonton and Calgary, articulated buses were acceptable in terms of technical performance, operational characteristics and maintenance requirements. Net cost savings can be realized. Based on the demonstration test results, economic advantages of articulated buses were clearly established.

Further Research Work Identified:

None

Project Number: 117
Subject: Articulated Buses
Submitted by: City of Edmonton/Edmonton Transit

Project Title: Articulated Vehicle Demonstration

Title of Report: I) Demonstration & Evaluation of Crown Ikarus 286 Articulated Diesel, December 1982
II) Demonstration & Evaluation of GMC New Look Articulated Bus, February 1983

Funding Source(s) and % Share: Alberta Transporation, (100%)

Consultants/Contractors Used: None

Total Project Cost: (all years) $30,000
Total Project Cost: (1983 only) -

Start Date: 1981
Completion Date: 1983

Project Manager: Salim Keshwani and L. Wahi

Dissemination of Results: By request to Transportation Department, TMD - Transit Planning, City of Edmonton

Project Objective, Scope, Background, and Methodology:

The objective of the demonstration was to assess the long term viability of the manufacturers; identify product distribution. Identify technical/mechanical characteristics of the test vehicles and highlight possible maintenance, operational or safety problems; assess the test vehicles operational service characteristics; survey passenger, operators, and mechanic for their opinion regarding the test bus; to identify capital and operating cost associated with the bus. The initial demonstration of articulated vehicles was initiated in July 1976 when the province of Alberta, City of Edmonton, and Calgary undertook a joint project to determine the economic feasibility of introducing articulated buses into the two cities. A Swedish Volvo and two West German M.A.N. articulated buses were tested at that time.

Project Results/Conclusions/Preliminary Findings:

The operational performance of the test buses were found to be comparable to the existing fleet of 40' GMC diesel buses. Crown had many desirable features such as good visual features, smooth acceleration, wide door and windows, etd. The GMC articulated bus encompassed many familiar characteristics of the present GM line of buses. Edmonton Transit was concerned with the GM's turntable mechanism. It was recommended that future Edmonton Transit purchases should include articulated buses.

Further Research Work Identified:

Project Number: 118
Subject: Other Service and Methods Demonstration
Submitted by: St. Catharines Transit Commission

Project Title: Braking and Traction Effect of Siped Tires

Title of Report: Report on the Results with the Use of a Marcy Tire Spier

Funding Source(s) and % Share: St. Catharines Transit Commission/Ontario Ministry of Transportation and Communications, (100%)

Consultants/Contractors Used: None

Total Project Cost: (all years) $3,576

Total Project Cost: (1983 only) $576

Start Date: -

Completion Date: -

Project Manager: John G. Compton, (416) 685-4228

Dissemination of Results: All CUTA members

Project Objective, Scope, Background, and Methodology:

To evaluate the benefit, if any, between standard rib tires and tires that have cut siping in the tread surface. Prior to the purchase of the Marcy Tire Siper, one of the ongoing complaints from the operators was poor brakes in rainy weather with buses equipped with heavy base contract tires. These tires, when the tread was worn down, were grooved with four grooves - but this did not completely prevent the hydro planing to provide a good grip on the road surface for braking or traction in wet or slippery weather. On receiving a Tire Siper, a before-and-after test was conducted on asphalt, which had been wet down with a fire hose, using unsiped and siped tires in conjunction with a tapely brake meter.

Project Results/Conclusions/Preliminary Findings:

With a 5307 GMC bus, equipped with six new unused tires on wet asphalt, stopping distance-unsiped tires at 20 m.p.h. was 22 feet - average of three runs. The stopping distance with the siped tires on the same bus, on the same wet asphalt was 18 feet, or an 18% improvement in the stopping distance. The stopping distance with the same bus and siped tires on dry asphalt at 20 m.p.h. was 17 feet. A 5307 GMC bus with heavy base tires, with the original tread worn off, on wet asphalt; the stopping distance at 20 m.p.h. was 25 feet. The same test run on siped tires, gave a stopping distance of 21 feet or an improvement of 14%. A 5307 GMC bus - 55 m.p.h. - contract tires worn almost to the cord, same wet asphalt at 20 m.p.h.; the stopping distance was 26 feet, while the same tires siped, nipping the cores on the same wet asphalt conditions, the stopping distance was 24 feet or 8% improvement. Prior to the Tire Siping Program, it was common to have 6 - 10 complaints a day during heavy rain or during slippery road conditions, in regard to poor braking control of the bus. However, since the Tire Siping Program, these complaints have been significantly reduced. Accident rate, when buses have struck the rear of another vehicle, is down 40% since January 1981. (A fact that may or may not be a direct result of the Tire Siping Program). In December of 1980, St. Catharines' average tire life was 87,000 miles average tire life. However, since the Tire Siping Program started in January of 1981 average tire life has increased 104,000 miles as of March 1983. St. Catharines Transit received a rebate on tire contract from Firestone Tire Co. of $1,138.08 for the previous four-months billing.

Further Research Work Identified:

St. Catharines Transit now sipes all transit bus tires from new to worn out.

COMPUTER APPLICATIONS AND DEVELOPMENT

Project Number: 119
Subject: Maintenance and Materials Management Systems
Submitted by: Montreal Urban Transit Commission

Project Title: GOUSIN (Optimal and Uniform Inventory Management)

Title of Report: None

Funding Source(s) and % Share: MUCTC (100%)

Consultants/Contractors Used: None

Total Project Cost: (all years) -
Total Project Cost: (1983 only) -

Start Date: 1982
Completion Date: September 1984 (Phase I)

Project Manager: Normand Gaboriault (514) 877-6428

Dissemination of Results:

Project Objective, Scope, Background, and Methodology:

To computerize inventory management, rationalize inventories, and standardize relative procedures. Also, to computerize accounts receivable.

Project Results/Conclusions/Preliminary Findings:

Anticipated benefits include reduced inventories, automatic re-ordering of stock based on demand, reduce accounts payable delays, decrease costs.

Further Research Work Identified:

Numéro du Projet 119
Sujet: Maintenance and Materials Management Systems
Soumis par: Commission de transport de la Communauté urbaine de Montréal

Titre du projet: GOUSIN (Gestion Optimale et Uniforme des Stocks en Inventaire)

Titre du rapport: Aucun

Source de financement et pourcentage des coûts défrayés par chaque organisme: CTCUM (100%)

Consultants/Sous-traitants: Aucun

Coût total: (toutes les années) -

Coût total du projet: (1983 seulement) -

Le projet débute le: 1982

Fin du projet: Septembre 1984 (Phase I)

Directeur du projet: Normand Gaboriault (514) 877-6428

Dissémination des résultats:

But, étendue, antécédents et méthodologie du projet:

Ce projet consiste à informatiser la gestion des stocks, à rationaliser les inventaires et à uniformiser les procédures s'y rattachant. De plus, on informatise le système de comptes à payer.

Résultats/Conclusions/Résultats préliminaires:

Ce projet devrait aider à: réduire les inventaires, se réapprovisionner automatiquement (en fonction de la demande), réduire les délais relatifs aux compte à payer, diminuer les coûts

Travail de recherche additionnel identifié:

Project Number: 120
Subject: Maintenance and Materials Management Systems
Submitted by: Montreal Urban Transit Commission

Project Title: GUIDE (Uniform and Computerized Maintenance Management)

Title of Report: None

Funding Source(s) and % Share: MUCTC (100%)

Consultants/Contractors Used: None

Total Project Cost: (all years) -   Total Project Cost: (1983 only) -

Start Date: 1984   Completion Date: 1986

Project Manager: Jean-Marie O'Hearn (514) 877-3978, Claude-André Poirier (514) 877-6420

Dissemination of Results:

Project Objective, Scope, Background, and Methodology:

This project was undertaken to computerize the management of vehicle maintenance and of facilities of the surface network and subway network.

Project Results/Conclusions/Preliminary Findings:

Anticipated benefits include reduced cost, reduce number of signalization, improve spare parts and vehicles, reduce unnecessary trips, increase expected life of materials, increase usage/collection of guarantees, decrease clerical work at the master's level.

Further Research Work Identified:

Numéro du Projet 120
Sujet: Maintenance and Materials Management Systems
Soumis par: Commission de transport de la Communauté urbaine de Montréal

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Titre du projet: GUIDE (Gestion Uniformisée et Informatisée De L'Entretien)

Titre du rapport: Aucun

Source de financement et pourcentage des coûts défrayés par chaque organisme: CTCUM (100%)

Consultants/Sous-traitants: Aucun

Coût total: (toutes les années) -   Coût total du projet: (1983 seulement) -

Le projet débute le: 1984   Fin du projet: 1986

Directeur du projet: Jean-Marie O'hearn (514) 877-3978, Claude-André Poirier (514) 877-6420

Dissémination des résultats:

But, étendue, antécédents et méthodologie du projet:

Ce projet consiste à informatiser la gestion de l'entretien des véhicules et des installations fixes du réseau de surface et du réseau métro.

Résultats/Conclusions/Résultats préliminaires:

Ce projet devrait aider à: réduire les coûts, diminuer le nombre de signalement, améliorer la qualité de l'entretien, diminution du parc de rechange (véhicules et pièces), réduction des déplacements inutiles, augmentation de la durée de vie des équipements, augmentation des récupérations des garanties, diminution du travail clérical au niveau de la maitrise.

Travail de recherche additionnel identifié:

Project Number: 121
Subject: Comprehensive Vehicle Monitoring Systems
Submitted by: Ontario Ministry of Transportation and Communications

Project Title: Transit Information Communications and Control system (TICCS)

Title of Report: None

Funding Source(s) and % Share: Ontario Ministry of Transportation and Communications, (100%)

Consultants/Contractors Used: Teleride/Sage

Total Project Cost: (all years) $6,200,000

Total Project Cost: (1983 only) $3,000,000

Start Date: June 1982

Completion Date: June 1986

Project Manager: John Ryell, MTC Transit Office, (416) 248-3785

Dissemination of Results: Products to be installed at the participating properties and Teleride/Sage will market products world-wide

Project Objective, Scope, Background, and Methodology:

To develop and implement a modular, flexible, comprehensive package of products to satisfy the information, communications, and control needs of the transit industry. Components to be developed: Communications, Operator and Bus Assignment (COBA); Automatic Vehicle, Location and Control (AVLC); Passenger Counting Collection (PCC); Service Analysis; Automatic Telephone Information System (ATIS); Public Information Display (PID); Trip Planning (TP); Mini-Scheduler (MS); Runcutter (RC); Rostering (ROS); Vehicle Maintenance System (VMS); Materials Management System (MMS); Timekeeping and Operator Bidding (TOB); Slip Administration (SLP); Quick-Scheduler (QS); Payroll/Personnel (PP); Financial Interfaces (FIN); Management Support Tools (MST). Details of COBA and TOB system being implemented in Ottawa are available separately.

Project Results/Conclusions/Preliminary Findings:

Currently being developed. Implementation of some components in a number of North American cities.

Further Research Work Identified:

Project Number: 122
Subject: Comprehensive Vehicle Monitoring Systems
Submitted by: Pachena Scientific & Industrial Electronics Inc.

Project Title: Automated Transit Vehicle Information System

Title of Report: Automated Transit Vehicle Information System

Funding Source(s) and % Share: Pachena Scientific & Industrial Electronics Inc.

Consultants/Contractors Used: Pachena Scientific & Industrial Electronics Inc./M.G. Art Industries

Total Project Cost: (all years) $152,000 Total Project Cost: (1983 only) $42,000

Start Date: September 1982 Completion Date: April 1984

Project Manager: N.J. McLean, Director of Engineering, (604) 420-2023

Dissemination of Results: Available from Pachena Scientific & Industrial Electronics Inc.

Project Objective, Scope, Background, and Methodology:

To design an accurate, low cost automatic passenger counting system, for transit vehicles, that is upgradable to include real time transmission of data via radio link and has extra inputs, extra I/O ports for connection to AVL equipment: Electronic destination signs and other peripheral devices as required (possibly including automatic farebox information). ATVIS will record all passenger activity on the vehicle and store it in none volatile memory in the unit until the data is removed from the unit by way of radio link or data retrieval unit. The design incorporates latest developments in microelectronics and propriety algorithms for the determination of passenger on-offs. This system is designed to be maintainable and has built in S/A features and when supplied to a customer, the customer will easily be able to maintain its own equipment - a needed feature in the rapidly changing electronics world.

Project Results/Conclusions/Preliminary Findings:

Preliminary findings to date are very promising and Pachena Scientific anticipates to be the supplier of the lowest cost, automatic passenger counting system available in North America. Pachena Scientific has successfully sold passenger counting systems to the city of Seattle for installation on 63 transit vehicles.

Further Research Work Identified:

Implementation of proprietary AVL equipment and development of magentic farecard readers for the transit industry.

Project Number: 123
Subject: Comprehensive Vehicle Monitoring Systems
Submitted by: Metro Transit Commission - Halifax/Department of Energy and Mines, (Nova Scotia)

- -

Project Title: Automated Transit Bus Information Service/Transinfo Project
Title of Report: None

Funding Source(s) and % Share: Federal Government, (14%)/Provincial Government, (4%)/Municipal Government, (82%)

Consultants/Contractors Used: City of Halifax

Total Project Cost: (all years) $1,355,000 Total Project Cost: (1983 only) -

Start Date: October 1, 1982 Completion Date: January 31, 1985

Project Manager: Charles Smith, (902) 421-7777

Dissemination of Results: All CUTA members

- -

Project Objective, Scope, Background, and Methodology:

To produce and implement a sophisticated and extensive computer information system within a sixteen month period. The project entails on-board bus equipment comprising two-way radios, automatic passenger counters, and a micro-processor. Sensors located on the buses relay immediate alarms to Central Control regarding maintenance problems. Includes the development of an automated passenger information service giving estimates of the actual (not scheduled) arrival times of all buses serving a bus. Bus arrival times are provided to public by telephone access to computer and information is real-time. Public display CRT units and on-street speaker phones provide real-time bus arrival information to public also. Access to computer for deaf persons can be obtained through telex interconnect. The information service will be designed to handle 1500 calls per hour. The system will also be used as a management tool to record and analyze statistics on key aspects of the system. Functions for maintenance scheduling, and a fuel and oil management program will also be included.

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Project Results/Conclusions/Preliminary Findings:

Project will not be completed before 1985. No results available at present.

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Further Research Work Identified:

Project Number: 124
Subject: Comprehensive Vehicle Monitoring Systems
Submitted by: Commission de transport de la Communauté régionale de l'Outaouais

- -

Project Title: Computerization of CTCRO's Operations

Title of Report: None

Funding Source(s) and % Share: Commission de transport de la Communauté régionale de l'Outaouais, (100%)

Consultants/Contractors Used: Niacad Ltd./Group Five Consulting/Fishbach & Moore Communications

Total Project Cost: (all years) $2,000,000 Total Project Cost: (1983 only) $2,000,000

Start Date: August 1983 Completion Date: October 1984

Project Manager: David Cain, Niacad Ltd., (613) 836-1944

Dissemination of Results: To the industry

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Project Objective, Scope, Background, and Methodology:

CTCRO is proceeding with the implementation of a computerized management and passenger information system using existing hardware and software. Implementation in the following area is currently underway. Automatic Vehicle Location (on-board odometre reset by signposts), Bus Systems Monitoring (brakes, air, and oil pressure), Automatic Passenger Counting (using pressure mats), Computerized Telephone Inquiry system (real time), Complete Radiotelephone Bus-Head Office Communications, Voice Recording of Bus-Head Office and Inquiry Sub-System Communication. Expected to be fully operational by the end of 1984, the system consists of a microprocessor and on-line communication device on every vehicle, 20 signposts, and a Prime 2250 central computer. Vehicles are polled for status every 20 seconds. The system allows driver-dispatch voice communications.

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Project Results/Conclusions/Preliminary Findings:

Inauguration tentative date: October 1984

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Further Research Work Identified:

Future computerization includes implementation in the following areas: Computerized Bus Maintenance System, Standardized Management Reports, Traffic Information Channelled to Radio Stations, Priority to Buses at Traffic Lights.

Project Number: 125
Subject: Comprehensive Vehicle Monitoring Systems
Submitted by: Toronto Transit Commission

Project Title: Communications and Information System (CIS)

Title of Report: C.I.S. - Phase VI

Funding Source(s) and % Share: Ontario Ministry of Transportation and Communications, (75%)/Toronto Transit Commission, (25%)

Consultants/Contractors Used: -

Total Project Cost: (all years) $5,400,000

Total Project Cost: (1983 only) $1,500,000

Start Date: 1980

Completion Date: September 1984

Project Manager: L.G. Berney, Toronto Transit Commission, (416) 481-4252

Dissemination of Results: Public Report

Project Objective, Scope, Background, and Methodology:

Overall aim is the development, testing, and implementation of a real time monitoring and control for surface vehicles. Phase VI includes testing of the C.I.S. system for a full operating division (Wilson) with 250 buses. The purpose of Phase VI was to obtain additional data to clarify the benefits and costs resulting from an initial test of 100 vehicles. Data collection for Phase VI is estimated at two months with before and after comparisons of the systems effectiveness. Phase VI software has been upgraded including a complete re-writing of the central program. Phase VI also includes the full testing of APC units utilizing pressure sensitive mats (as opposed to infra-red light beams)

Project Results/Conclusions/Preliminary Findings:

C.I.S. improves control of surface fleet operations, contributing to faster response to operational problems resulting in better schedule adherence. Additional information available on operations has contributed to improved scheduling, in some cases vehicle savings.

Further Research Work Identified:

Phase VII - Extend C.I.S. to other divisions and integrate C.I.S. divisional control with central control.

Project Number: 126
Subject: Comprehensive Vehicle Monitoring Systems
Submitted by: Kitchener Transit

Project Title: Kitchener Transit Communication and Information System

Title of Report: Not yet determined

Funding Source(s) and % Share: Ontario Ministry of Transportation and Communications, (75%)/Municipalities of Kitchener-Waterloo, (25%)

Consultants/Contractors Used: Don Bonner, Consultant, and others as required

Total Project Cost: (all years) $1,500,000
Total Project Cost: (1983 only) $50,000

Start Date: 1982
Completion Date: 1987

Project Manager: W.T. Beck, Kitchener Transit, (519) 885-7288

Dissemination of Results: Not yet determined

Project Objective, Scope, Background, and Methodology:

The objective of the project is to develop a computerized communication and information system consisting of: A total fleet radio system, automatic passenger counting, scheduling and runcutting, dispatching, automatic vehicle location, time keeping, vehicle maintenance, inventory control, and automatic telephone information system to improve the efficiency and effectiveness of the transit service. The implementation of the various applications have been phased over a five year period. In 1982, a detailed cost/benefit analysis was conducted prior to adopting this project. Several different alternatives were evaluated by Kitchener Transit under a format devised by the Ontario Ministry of Transportation and Communications, known as "Transit Control and Information Systems Evaluation Guidelines".

Project Results/Conclusions/Preliminary Findings:

It is anticipated that the initial phase of acquiring and installing the appropriate computer, the necessary software, radio system connecting all buses, an automatic passenger counting system and computer scheduling and runcutting will be completed in 1984.

Further Research Work Identified:

Project Number: 127
Subject: Comprehensive Vehicle Monitoring Systems
Submitted by: City of Edmonton/Edmonton Transit

Project Title: Identification & Evaluation of Automatic Vehicle Monitoring System

Title of Report: i) Preliminary Functional and Operational Requirement of Passenger Counting System
ii) APC - Recommendations for Further Development

Funding Source(s) and % Share: Alberta Transportation, (66%)/City of Edmonton, (33%)

Consultants/Contractors Used: None

Total Project Cost: (all years) $6,000
Total Project Cost: (1983 only) $3,000

Start Date: April 1983
Completion Date: -

Project Manager: Salim Keshwani, Projects Engineer

Dissemination of Results: By request to Transportation Department, TMD - Transit Planning, City of Edmonton

Project Objective, Scope, Background, and Methodology:

Identify and evaluate application of an Automatic Passenger Counting System for Edmonton Transit System wide route evaluation. The system to be capable of providing in greater detail and coverage all the data presently provided by current on-board route evaluation. At present, these data could be up to three years old. The following requirements were identified: data, software, system, hardware. Estimates of the cost of APC, i.e. Capital and Operating costs. Comparison of cost of surveying routes by on-board survey vs APC's. Recommendation for further development.

Project Results/Conclusions/Preliminary Findings:

The ideal system to meet the needs of Edmonton Transit and Transportation Section was identified. It is similar to the one recommended by CUTA except for one major difference. Transit's system calls for integration with registering fareboxes so that fare categories can also be obtained. This eliminates completely the need for on-board data collection.

Further Research Work Identified:

To purchase five units for evaluation and development of the software.

Project Number: 128
Subject: Comprehensive Vehicle Monitoring Systems
Submitted by: Gandalf Data Ltd.

Project Title: Transit Data Unit

Title of Report: None

Funding Source(s) and % Share: Gandalf Data Ltd.

Consultants/Contractors Used: Nil

Total Project Cost: (all years) -
Total Project Cost: (1983 only) -

Start Date: September 1983
Completion Date: September 1984

Project Manager: John Seymour, Gandalf Data Ltd., (613) 225-0565

Dissemination of Results: Internal

Project Objective, Scope, Background, and Methodology:

Complete the development of a commercial product designed to meet the specialized needs of the transit industry, including real-time status reporting, alarm monitoring, automatic vehicle location (signpost, odometer) and automatic passenger counting.

Project Results/Conclusions/Preliminary Findings:

Initial systems are to be installed in Hull, Québec (Fall 1984).

Further Research Work Identified:

Project Number: 129
Subject: Comprehensive Vehicle Monitoring Systems
Submitted by: OC Transpo

Project Title: COBA (Communications Operator/Bus Assignment)

Title of Report: None

Funding Source(s) and % Share: Ontario Ministry of Transportation and Communications, (100%)

Consultants/Contractors Used: Teleride/Sage/KVA Communications & Electronics

Total Project Cost: (all years) $700,000
Total Project Cost: (1983 only) -

Start Date: September 1980
Completion Date: September 1984

Project Manager: -

Dissemination of Results: -

Project Objective, Scope, Background, and Methodology:

The objective of the COBA System project is to develop a comprehensive transit information, communications and control system through the integration of voice radio communications and computer systems. To minimize non-essential communications between the Control Centre and buses the COBA system automatically displays the vehicle number, route/run numbers, operator number and the scheduled position of buses calling Control. Control Centre, Public Information and Customer Service personnel are provided with computer displays of transit schedules a route description as well as the facility to log data for automated passenger information systems and management reports. Schedule adherence is monitored through a psuedo automatic vehicle locator system utilizing bus stop numbers and scheduled position of vehicles.

Project Results/Conclusions/Preliminary Findings:

Preliminary findings indicate that COBA supplies more detailed and current data on which service can be monitored and controlled. Automated passenger information is more comprehensive and more effective use of resources results in reduced operating expenditures.

Further Research Work Identified:

Project Number:	130 -
Subject:	Comprehensive Vehicle Monitoring Systems
Submitted by:	Dynamic Sciences Ltd.

Project Title:	A Ride Monitor System for Maintaining a Fleet of Railway Passenger Cars		
Title of Report:	None		
Funding Source(s) and % Share:	Transportation Development Centre, (100%)		
Consultants/Contractors Used:	Dynamics Sciences Ltd.		
Total Project Cost: (all years)	$15,000	Total Project Cost: (1983 only)	-
Start Date:	1982	Completion Date:	1984
Project Manager:	Pierre Marcotte		
Dissemination of Results:	Transportation Development Centre		

Project Objective, Scope, Background, and Methodology:

An investigation to define a possible car ride monitor system to continuously monitor ride characteristics in service for purposes of vehicle and track maintenance. The report defines possible alternatives, reviews respective requirements and discusses feasibility. Investigation activities included a literature survey and an assessment of approaches taken by various railways. Documentation of off-the-shelf hardware was also reviewed. From these data, various alternatives were examined and compared. A candidate system was subsequently identified and presented.

Project Results/Conclusions/Preliminary Findings:

Other railways take a variety of approaches such as track geometry cars, verbal reports, etc., but none provide adequate basis for monitoring vehicles and track. Modern electronic hardware makes feasible a practical continuous monitoring system of vehicles and track with exception reporting. Transfer of routine data base allows establishment of fleet and track averages from which sub-standard performance can be identified.

Further Research Work Identified:

A practical application with a car fleet operator.

Project Number: 131
Subject: Automatic Passenger Counting Systems
Submitted by: Transportation Development Centre

- -

Project Title:	Urban Transit R & D		
Title of Report:	Automatic Passenger Counting: Uniform Functional Requirement Definition		
Funding Source(s) and % Share:	Transportation Development Centre, (100%)		
Consultants/Contractors Used:	Transvision Consultants Ltd./Group Five Consulting Ltd. in cooperation with the Canadian Urban Transit Association		
Total Project Cost: (all years)	$16,900	Total Project Cost: (1983 only)	$16,540
Start Date:	March 31, 1983	Completion Date:	March 14, 1984
Project Manager:	L. Suen, (514) 283-4100		
Dissemination of Results:	Limited number of copies available from Transportation Development Centre and the Canadian Urban Transit Association		

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Project Objective, Scope, Background, and Methodology:

The use of Automatic Passenger Counting Systems by Canadian transit operators has been characterized by diverging views on their application, rationale, and methodology. APC systems have generally been tailormade for a specific application with little realization of the potential benefits of uniformity of design and application. CUTA and TDC recognized the existing problems with APC systems and undertook a project that attempted to improve the utilization of APC systems by Canadian transit properties and improve the market so that systems reliability and support could be assured. The project involved a literature search and selected contacts with transit operators to determine the APC systems available, current Canadian and international applications, existing suppliers, and current user perspectives. Preliminary functional requirements were defined based on the above and presented at a workshop on APC systems (for discussion purposes). Final uniform functional requirements were developed using the results of the APC workshop.

- -

Project Results/Conclusions/Preliminary Findings:

A system's approach is needed in the purchase of APC systems and benefits can result from the appropriate use of APC systems. Uniform functional requirements can produce cost savings for manufacturers and transit systems due to economies of scale. Uniform functional requirements have been agreed upon in principle including definitions of the system hardware (base equipment and optional modules), data parametres (system inputs), report generation (system outputs), and operational standards (eg. accuracy, reliability, maintenance, etc.)

- -

Further Research Work Identified:

None

Project Number: 132
Subject: Automatic Passenger Counting Systems
Submitted by: Red Pine Instruments Ltd.

Project Title: Automatic Passenger Counters - SCRTD (Los Angeles)

Title of Report: Not known

Funding Source(s) and % Share: SCRTD, (100%)

Consultants/Contractors Used: Red Pine Instruments Ltd.

Total Project Cost: (all years) $17,190 Total Project Cost: (1983 only) $15,000

Start Date: May 1983 Completion Date: December 1984

Project Manager: Paul Isaacs, Red Pine Instruments, (613) 333-2776

Dissemination of Results: SCRTD

Project Objective, Scope, Background, and Methodology:

To supply Infra-Red Lightheads and Motorola 6803 based microprocessors to Southern California Rapid Transit as a demonstration project. Thirteen buses were to be equipped. SCRTD is comparing lighthead versus counter mat accuracy.

Project Results/Conclusions/Preliminary Findings:

Not yet available.

Further Research Work Identified:

Project Number: 133
Subject: Automatic Passenger Counting Systems
Submitted by: Red Pine Instruments Ltd.

Project Title: Automatic Passenger Counting System - Tri-Met (Portland)

Title of Report: None

Funding Source(s) and % Share: Tri-County Metropolitan Transportation District of Oregon/UMTA, (100%)

Consultants/Contractors Used: Red Pine Instruments Ltd.

Total Project Cost: (all years) $300,000
Total Project Cost: (1983 only) $109,000

Start Date: May 1982
Completion Date: June 1984

Project Manager: Paul Isaacs, Red Pine Instruments, (613) 333-2776

Dissemination of Results: Tri-County Metropolitan Transportation District of Oregon

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Project Objective, Scope, Background, and Methodology:

To provide Infra-Red Lightheads and Motorola 6809 based microprocessors for 50 buses (including 8 articulated buses). To provide automatic passenger court data removal via Infra-Red Data Link.

Project Results/Conclusions/Preliminary Findings:

Fourty-two buses are equipped and collecting passenger court data. The Infra-Red Data Link is successful. Data removal takes place in three garages.

Further Research Work Identified:

Project Number:	134
Subject:	Automatic Passenger Counting Systems
Submitted by:	OC Transpo/Red Pine Instruments Ltd.

- -

Project Title:	Automated Passenger Counting - Radio Transmission		
Title of Report:	None		
Funding Source(s) and % Share:	Ontario Ministry of Transportation and Communications, (100%)		
Consultants/Contractors Used:	KVA Communications/Red Pine Instruments Ltd.		
Total Project Cost: (all years)	$29,000	Total Project Cost: (1983 only)	-
Start Date:	October 1, 1983	Completion Date:	March 31, 1984
Project Manager:	Herman Van der Laag, KVA Communications, (416) 661-6644		
Dissemination of Results:	Results available upon request		

- -

Project Objective, Scope, Background, and Methodology:

To transmit collected data by way of radio waves rather than the present method of physical disk transfer. This is a prototype development project to be applied across OC Transpo fleet of 66 passenger counting equipped buses when satisfactory results are obtained.

- -

Project Results/Conclusions/Preliminary Findings:

To eliminate loss of data, time, and cost through disk unit failure.

- -

Further Research Work Identified:

After successful prototype development radio modifications will be made to 66 buses and a full system implementatio will be undertaken.

Project Number: 135

Subject: Automatic Passenger Counting Systems

Submitted by: KVA Communications/Red Pine Instruments Ltd.

Project Title: Automated Data Retrieval System

Title of Report: Automated Data Retrieval System Description

Funding Source(s) and % Share: OC Transpo, (100%)

Consultants/Contractors Used: KVA Communications and Electronics Co./Red Pine Instruments Ltd.

Total Project Cost: (all years) $54,000

Total Project Cost: (1983 only) $26,000

Start Date: October 1983

Completion Date: October 1984

Project Manager: J. Herman Vanderlaag, (416) 661-6644

Dissemination of Results: OC Transpo

Project Objective, Scope, Background, and Methodology:

To design and implement a prototype system providing direct computer retrieval of accumulated bus information via an existing radio communications system. The system consists of an interface between an existing data collection unit on-board approximately 70 vehicles and an existing radio system. When completed, will allow automated retrieval of accumulated bus data during non-peak hours over the radio. This is a joint project between KVA Communications, Red Pine Instruments Ltd., and OC Transpo. OC Transpo are providing software for their VAX computer, Red Pine is responsible for hardware design and firmware for bus interface units, while KVA has overall system design and project management responsibilities.

Project Results/Conclusions/Preliminary Findings:

Prototype hardware has been built and is currently in final stages of testing. VAX software is undergoing final debugging stage. If successful, system will greatly reduce labour currently associated with manual retrieval of accumulated bus data.

Further Research Work Identified:

Project Number:	136
Subject:	Transit Information Systems
Submitted by:	Toronto Transit Commission

Project Title:	Timeline		
Title of Report:	Timeline Evaluation		
Funding Source(s) and % Share:	Ontario Ministry of Transportation and Communications, (100%)		
Consultants/Contractors Used:	Teleride/Sage		
Total Project Cost: (all years)	$400,000	Total Project Cost: (1983 only)	-
Start Date:	1981	Completion Date:	1985
Project Manager:	D. Mair, Toronto Transit Commission, (416) 481-4252		
Dissemination of Results:	Public report to Commission		

Project Objective, Scope, Background, and Methodology:

To evaluate "Telerider" suitability for TTC and to identify benefits to the TTC and its riders. "Timeline" is a computerized telephone information system that allows riders to call a telephone number assigned to the nearest bus stop to find out when the next bus will arrive. The system was tested on 11 routes in South Etobicoke. Prior to its implementation on information campaign of the neighborhoods along the routes was carried out.

Project Results/Conclusions/Preliminary Findings:

Results - no measurable increase in ridership. Final results to be available in Fall 1984.

Further Research Work Identified:

Project Number: 137
Subject: Transit Information Systems
Submitted by: Kitchener Transit

Project Title: Telerider 200 Demonstration Project

Title of Report: Not yet determined

Funding Source(s) and % Share: Ontario Ministry of Transportation and Communications, (100% of capital and engineering costs)/Operating costs shared between Kitchener, (54.1%)/Guelph, (27.7%), and Brantford, (18.2%)

Consultants/Contractors Used: Teleride/Sage

Total Project Cost: (all years) $1,000,000
Total Project Cost: (1983 only) $94,000

Start Date: February 1, 1982
Completion Date: August 1985

Project Manager: John Ryell, MTC Transit Office, (416) 248-3785

Dissemination of Results: Not yet determined

Project Objective, Scope, Background, and Methodology:

The objective of the demonstration project is to determine the feasibility of providing an automatic telephone information system in small and medium sized transit properties by sharing capital and start-up costs for a centrally located computer, the necessary software, and marketing. The project involves transit systems in Kitchener-Waterloo, Guelph, and Brantford, four cities in Southern Ontario that are situated within a 40 kilometre radius. The project will be evaluated in terms of costs and benefits, changes in ridership and revenue, passenger satisfaction, utilization of the automatic telephone information system, problems encountered, and future prospects.

Project Results/Conclusions/Preliminary Findings:

Although there has not been an extensive evaluation of the total project, preliminary findings suggest that for the cities of Kitchener-Waterloo alone, there is a higher than expected usage of the automatic telephone information system.

Further Research Work Identified:

Major enhancements to the existing system will be made during the course of the demonstration project.

Project Number:	138
Subject:	Transit Information Systems
Submitted by:	Ontario Ministry of Transportation and Communications

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Project Title:	Service Bureau Demonstration Between GO Transit and Oakville Transit		
Title of Report:	GO Transit - Oakville Transit ATIS Demonstration		
Funding Source(s) and % Share:	Ontario Ministry of Transportation and Communications/Oakville Transit, (100%)		
Consultants/Contractors Used:	Teleride/Sage		
Total Project Cost: (all years)	Not yet available	Total Project Cost: (1983 only)	Not yet available
Start Date:	To be determined	Completion Date:	-
Project Manager:	M. Cautillo, MTC Transit Office, (416) 248-3785		
Dissemination of Results:	To be determined		

Project Objective, Scope, Background, and Methodology:

The MTC is proposing to initiate a Service Bureau demonstration between GO Transit and Oakville Transit. The objective is to test the feasibility of establishing an integrated automated transit information system utilizing a centrally located computer. The ultimate concept of the Service Bureau is to provide a computerized information service to municipal transit properties that interconnect with GO Transit. As well as providing telephone arrival times for the local transit system, passengers would also receive information on connecting GO services. A cursory examination has indicated that possible economies of scale exist if the various systems are coordinated rather than established on an individual basis. Project is still in planning stage.

Project Results/Conclusions/Preliminary Findings:

To be determined.

Further Research Work Identified:

To be determined.

Project Number: 139
Subject: Transit Information Systems
Submitted by: City of Edmonton/Edmonton Transit

Project Title: CATIS Itinerary Planning Research Project

Title of Report: Not known

Funding Source(s) and % Share: Alberta Transportation, (67%)/Edmonton Transit, (33%)

Consultants/Contractors Used: Internal - Edmonton Transit

Total Project Cost: (all years) -

Total Project Cost: (1983 only) -

Start Date: October 1983

Completion Date: -

Project Manager: Doug Wessel, Edmonton Transit, (403) 428-5525

Dissemination of Results: -

Project Objective, Scope, Background, and Methodology:

This is the result of the implementation of the recommendations of the Feasibility Study - Telephone Information Systems completed in September 1983. Existing data and structures are being evaluated, modified, and enhanced to improve their utility to the Computer Assisted Telephone Information System (CATIS). Algorythm research is also intended. The final results will be a working model of the final system that will be developed and installed. To date some benchmarking of hardware alternatives has been completed.

Project Results/Conclusions/Preliminary Findings:

An interim report regarding the benchmark tests thus far conducted will be made available in June 1984. Other results are to be announced.

Further Research Work Identified:

Project Number: 140
Subject: Transit Information Systems
Submitted by: City of Edmonton/Edmonton Transit

Project Title: Feasibility Study - Telephone Information System

Title of Report: Telephone Information Systems for Edmonton Transit

Funding Source(s) and % Share: Alberta Transportation, (67%)/Edmonton Transit, (33%)

Consultants/Contractors Used: None

Total Project Cost: (all years) $50,000 Total Project Cost: (1983 only) $44,000

Start Date: November 1982 Completion Date: September 1983

Project Manager: Doug Wessel, Edmonton Transit, (403) 428-5525

Dissemination of Results: Reports to Alberta Transportation. Limited number of additional copies available to CUTA members from Edmonton Transit

Project Objective, Scope, Background, and Methodology:

Conceptually there are two approaches to the dissemination of transit information to the public. One method involves a one-way presentation of pre-determined information and the other method involves a dialogue between the source and destination wherein more precise and complex information may be disseminated. Both methods lend themselves to automation to some extent. The objective was to determine which method best suited the needs of the citizens of Edmonton and then to what extent automation could cost effectively assist in the implementation of that method.

Project Results/Conclusions/Preliminary Findings:

For Edmonton, it was determined that interaction was the appropriate method both because of historical presidence (expectations) and because of the higher quality (precision) of information that could be provided. It was further recommended that computers could provide a valuable and long-term cost-effective assistance to information clerks in their ongoing dialogues with the public.

Further Research Work Identified:

A need for further research was identified in three areas: Matching of current transit information to the needs of such a system (includes identifying information requirements), evaluation and selection of most appropriate time expanded network analysis algorythm, and evaluation for selection of the most appropriate computing hardware.

Project Number: 141
Subject: Transit Information Systems
Submitted by: St. John's Transportation Commission

Project Title:	Computerized Telephone Answering System for St. John's Transportation Commission		
Title of Report:	Computerized Telephone Answering System for St. John's Transportation Commission		
Funding Source(s) and % Share:	St. John's Transportation Commission, (100%)		
Consultants/Contractors Used:	Teleride/Sage Ltd.		
Total Project Cost: (all years)	-	Total Project Cost: (1983 only)	-
Start Date:	January 1984	Completion Date:	February 1984
Project Manager:	J.L. Pitcher, (709) 722-9400		
Dissemination of Results:	Members of Commission		

Project Objective, Scope, Background, and Methodology:

To install a computerized telephone answering system for St. John's Metrobus to improve efficiency in relating bus schedule information to the public.

Project Results/Conclusions/Preliminary Findings:

Such a system would be beneficial but the installation of the system is dependent on obtaining sufficient funding.

Further Research Work Identified:

Project Number: 142
Subject: Transit Information Systems
Submitted by: Transportation Development Centre

Project Title:	Transportation Information for Expo 86		
Title of Report:	Feasibility and Design: A Vancouver Area Integrated Transportation Information System		
Funding Source(s) and % Share:	Transportation Development Centre, (62%), BC Ministry of Energy, Mines and Petroleum Resources (38%)		
Consultants/Contractors Used:	B.C. Ministry of Energy, Mines and Petroleum Resources		
Total Project Cost: (all years)	$29,880	Total Project Cost: (1983 only)	$20,000
Start Date:	January 1, 1984	Completion Date:	May 30, 1984
Project Manager:	L. Suen, (514) 283-4100		
Dissemination of Results:	Limited number of copies available from Transportation Development Centre		

Project Objective, Scope, Background, and Methodology:

To evaluate application of modern telecommunications and computer technology to metropolitan and inter-regional transportation information system (TIS). To design a demonstration TIS for use in Greater Vancouver during Expo 86 using novel Canadian technology in energy efficient transportation management. Project work includes state-of-the-art review, evaluation, methodology design and plan for implementation, and identification of suppliers and users, actual implementation and evaluation could proceed upon completion of this work, based upon specific assessment of feasibility, cost, time frame, and effort required.

Project Results/Conclusions/Preliminary Findings:

The system was evaluated and its workability assessed for a demonstration in Vancouver. A more detailed ITIS desig implementation plans, and an in-field evaluation program was developed.

Further Research Work Identified:

To implement an ITIS prototype demonstration during EXPO '86.

Project Number:	143		
Subject:	Communication and Control Systems		
Submitted by:	Toronto Transit Commission		

Project Title:	Computerized Train Dispatch and Information System		
Title of Report:	Computerized Train Dispatch and Information System		
Funding Source(s) and % Share:	Ontario Ministry of Transportation and Communications, (75%)/Toronto Transit Commission, (25%)		
Consultants/Contractors Used:	None		
Total Project Cost: (all years)	$700,000	Total Project Cost: (1983 only)	$50,000
Start Date:	1978	Completion Date:	1984
Project Manager:	P. Devereux, Toronto Transit Commission, (416) 481-4252		
Dissemination of Results:	T.T.C. Management		

Project Objective, Scope, Background, and Methodology:

Computerized assist for control of subway operations involving terminal departures, intermediate point headway control, and delay recovery strategies.

Project Results/Conclusions/Preliminary Findings:

Difficulties have been experienced in using the existing signal system information as input to the central control computer. Current efforts are directed at improving train tracking before proceeding further with control facilities.

Further Research Work Identified:

Intermediate point headway control, delay recovery.

Project Number: 144
Subject: Communication and Control System
Submitted by: Sel Canada

Project Title: Automatic Train Control System

Title of Report: Same as above

Funding Source(s) and % Share: Sel Canada, (100%)

Consultants/Contractors Used: None

Total Project Cost: (all years) N/A
Total Project Cost: (1983 only) N/A

Start Date: 1982
Completion Date: December 31, 1985

Project Manager: R. Spannagel/W. Friesen, (416) 223-8611

Dissemination of Results: To customer/user

Project Objective, Scope, Background, and Methodology:

Develop "Vital" (safe) train control system to provide for totally driverless operation of a transit system, including the mainline operation and storage yard control. Storage yard control is to include automatic, remote, driverless coupling, and uncoupling of trains.

Project Results/Conclusions/Preliminary Findings:

Demonstration of automatic driverless operation successfully completed and preliminary testing of automatic coupling/uncoupling successfully completed.

Further Research Work Identified:

Project Number: 145
Subject: Communication and Control Systems
Submitted by: Ontario Ministry of Transportation and Communications

- -

Project Title:	Communication and Control System Study		
Title of Report:	Communication and Control System for GO Transit		
Funding Source(s) and % Share:	GO Transit, (100%)		
Consultants/Contractors Used:	To be determined		
Total Project Cost: (all years)	To be determined	Total Project Cost: (1983 only)	To be determined
Start Date:	March 12, 1984	Completion Date:	-
Project Manager:	Frances Chung, GO Transit, (416) 630-5220		
Dissemination of Results:	GO Transit and GO/ALRT		

- -

Project Objective, Scope, Background, and Methodology:

To identify and categorize the immediate and future communication network requirements and monitoring control needs of GO Transit; to identify options available to meet those needs and requirements; to recommend appropriate option(s) to be adopted. In the course of the study, conventional communication technologies as well as emerging technologies will be examined. Emphasis is also stressed on the flexibility for future integration with GO/ALRT's communication and control system.

- -

Project Results/Conclusions/Preliminary Findings:

To be determined.

- -

Further Research Work Identified:

Subject to GO Transit's acceptance of the recommended option(s), Phase 2 of the assignment would be to develop an implementation plan.

Project Number: 146
Subject: Communication and Control Systems
Submitted by: Toronto Transit Commission

Project Title:	Transit Control Study		
Title of Report:	Transit Control Study		
Funding Source(s) and % Share:	Toronto Transit Commission, (100%)		
Consultants/Contractors Used:	None		
Total Project Cost: (all years)	$50,000	Total Project Cost: (1983 only)	$30,000
Start Date:	1983	Completion Date:	1984
Project Manager:	J. Thomas, Toronto Transit Commission, (416) 481-4252		
Dissemination of Results:	T.T.C. Management		

Project Objective, Scope, Background, and Methodology:

The purpose of the project is to determine the long range system central control requirements for the T.T.C. Rapid Transit System including facility for operations control, power control, and voice and data communications. This is in response to the need for additional control facilities for the Scarborough RT and the limited space for additional facilities that could be accommodated within the existing transit control centre. The need for additional control facilities to the year 2000 were identified, technology options for expansion evaluated and operational and cost impacts estimated.

Project Results/Conclusions/Preliminary Findings:

Report completed March 1984. Conclusions restricted to internal use only.

Further Research Work Identified:

N/A

Project Number: 147
Subject: Communication and Control Systems
Submitted by: Montreal Urban Transit Commission

Project Title: Integrated Communications Network at the MUCTC

Title of Report: Integration (Total or Partial) of Communications Networks

Funding Source(s) and % Share: Ministry of Transport of Quebec (100%)

Consultants/Contractors Used: to be determined

Total Project Cost: (all years) $2,000,000
Total Project Cost: (1983 only) $100,000

Start Date: -
Completion Date: -

Project Manager: Jean-Denis Pelletier (514) 877-6077

Dissemination of Results:

Project Objective, Scope, Background, and Methodology:

Integrate the various communication networks existing in the various properties and the subway system of the CTCUM. Define, analyze and specify needs of every department of the MUCTC for data transmission, voice transmission, and image transmission for the next decade. Specify the communication network based on the proposed system including account substructures, agreements between the MUCTC and phone company, telecomputer network, and of the geographical location of the MUCTC's facilities.

Project Results/Conclusions/Preliminary Findings:

No results available.

Further Research Work Identified:

Numéro du Projet 147

Sujet: Communication and Control Systems

Soumis par: Commission de transport de la Communauté urbaine de Montréal

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Titre du projet: Réseau intégré de communications à la CTCUM

Titre du rapport: Intégration (totale ou partielle) des réseaux de communications

Source de financement et pourcentage des coûts défrayés par chaque organisme: Ministère des Transports du Quebec (100%)

Consultants/Sous-traitants: En instance de choix

Coût total: (toutes les années) $2,000,000

Coût total du projet: (1983 seulement) $100,000

Le projet débute le: -

Fin du projet: -

Directeur du projet: Jean-Denis Pelletier (514) 877-6077

Dissémination des résultats:

But, étendue, antécédents et méthodologie du projet:

Réaliser l'intégration des différents réseaux de communications entre les différentes propriétés de la CTCUM et le réseau souterrain du métro. Définir, analyser et préciser les besoins propres aux différents services de la CTCUM concernant la transmissions de données, la transmission de voix et la transmission d'images, et ce, pour la prochaine décennie. Définir le réseau de communications en fonction du système proposé en tenant compte des infrastructures actuelles, des engagements de la Commission vis à vis la téléphonie, du réseau de téléinformatique et de la location des différentes propriétés de la Commission.

Résultats/Conclusions/Résultats préliminaires:

Résultats non disponibles.

Travail de recherche additionnel identifié:

Project Number:	148
Subject:	Communication and Control Systems
Submitted by:	Sel Canada

- -

Project Title:	Electronic (u-computer) Signal System for Trains		
Title of Report:	Same as above		
Funding Source(s) and % Share:	Sel Canada, (100%)		
Consultants/Contractors Used:	None		
Total Project Cost: (all years)	N/A	Total Project Cost: (1983 only)	N/A
Start Date:	1981	Completion Date:	December 15, 1984
Project Manager:	W. Friesen, (416) 223-8611		
Dissemination of Results:	Internal		

- -

Project Objective, Scope, Background, and Methodology:

Investigate methods for effective use of micro-computer technology for railway signal systems and develop methodology for implementation in a "Vital" manner. Develop costing methodology as a method of preparing overall signal system installation cost estimates. Included are areas such as "Vital" communication links and remote control systems.

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Project Results/Conclusions/Preliminary Findings:

Findings to date indicate that present technology permits an effective use of u-computers in this field.

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Further Research Work Identified:

Project Number:	149
Subject:	Communication and Control Systems
Submitted by:	Catcom Systems Corp.

- -

Project Title:	CN Rail Dispatched Voice/Data Communication System		
Title of Report:	CN Rail Requirements Specification		
Funding Source(s) and % Share:	CN Rail, (100%)		
Consultants/Contractors Used:	None		
Total Project Cost: (all years)	$250,000	Total Project Cost: (1983 only)	$150,000
Start Date:	April 1983	Completion Date:	September 1984
Project Manager:	R. Fraser, Catcom Systems Corp.		
Dissemination of Results:	Proprietary		

- -

Project Objective, Scope, Background, and Methodology:

System and hardware design of new generation voice/data communication system to upgrade and integrate the existing engineering and transportation communication system of CN Rail on the B.C. Northline route.

- -

Project Results/Conclusions/Preliminary Findings:

Not available.

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Further Research Work Identified:

Project Number:	150
Subject:	Communication and Control Systems
Submitted by:	Glenayre Electronics

Project Title:	Automatic Rail Car Identification		
Title of Report:	Automatic Rail Car Identification		
Funding Source(s) and % Share:	Transportation Development Centre, (64.2%)/Glenayre Electronics Ltd., (35.8%)		
Consultants/Contractors Used:	N/A		
Total Project Cost: (all years)	$624,800	Total Project Cost: (1983 only)	$50,465.95
Start Date:	October 22, 1981	Completion Date:	March 31, 1985
Project Manager:	R.J. Pomeroy		
Dissemination of Results:	Transportation Development Centre		

Project Objective, Scope, Background, and Methodology:

The aim of this project is to improve railway operating efficiency through the development of an automatic car identification system. In the mid-1960's, the railways developed a standardized optical system for automatic car identification, but the system did not meet expected performance levels and was removed from service in 1977. The need for a highly reliable, accurate system for automatic rail car identification remains, as it would provide railways with substantial operating benefits by eliminating manual reading of labels on each car departing or entering a terminal. The specific objective of this project is to develop and test a passive rail car identification transponder, a field programming unit to set the car number in the transponder and a controller/interrogator to read the transponder. The successful development of a practical automatic car identification system would benefit not only railways but also other transportation operators, including bus and truck companies.

Project Results/Conclusions/Preliminary Findings:

The Railocator System comprises car mounted transponders, an antenna installed between the rails and wayside mounted reader, and communications interface. Prototype equipment has been built and laboratory tested with outstandingly good reliability and performance. A single chip VLSI version of the transponder has been prototyped. A field demonstration on a major Canadian railroad is now being planned.

Further Research Work Identified:

Project Number: 151
Subject: Communication and Control Systems
Submitted by: Sel Canada

Project Title: Use of Wheel Detectors for Train Location Identification

Title of Report: Use of Wheel Detectors for Train Location Identification

Funding Source(s) and % Share: Sel Canada, (100%)

Consultants/Contractors Used: None

Total Project Cost: (all years) N/A

Total Project Cost: (1983 only) N/A

Start Date: -

Completion Date: -

Project Manager: W. Friesen, (416) 223-8611

Dissemination of Results: Internal

Project Objective, Scope, Background, and Methodology:

To provide train location identification in high noise environments as presented by electrified railways, including the use of electric track brakes. Use of wheel detectors for this purpose is investigated, including field tests/demonstrations.

Project Results/Conclusions/Preliminary Findings:

Field demonstrations to date indicate a high success rate in accurate detection of trains at speeds from 0 to 200 kph. Trains equipped with track brakes have also been used with good results.

Further Research Work Identified:

Project Number: 152
Subject: Scheduling/Runcutting/Dispatching - Regular Transit
Submitted by: Nova Scotia Research Foundation

Project Title: Vehicle Routing and Scheduling Package

Title of Report: None

Funding Source(s) and % Share: Nova Scotia Research Foundation Corporation, (100%)

Consultants/Contractors Used: Operational Research Group, Nova Scotia Research Foundation Corporation

Total Project Cost: (all years) $15,000 Total Project Cost: (1983 only) $7,000

Start Date: April 1982 Completion Date: July 1983

Project Manager: Chang H. Park, (902) 424-8670

Dissemination of Results: None

Project Objective, Scope, Background, and Methodology:

The project was primarily concerned with the development of a systematic approach to design and schedule vehicle routes to improve the fuel efficiency and resource utilization. The system was aimed at the distribution system and a school bus operation, however, a similar approach could be applied to public transit also. A mathematical modelling technique was employed and the routing system was implemented on a main frame computer.

Project Results/Conclusions/Preliminary Findings:

Two case studies were performed and resulted in a significant improvement in total mileage and vehicle utilization.

Further Research Work Identified:

Converting the computer program to a more accessible hardware (eg. mini-computer or micro-computer).

Project Number: 153
Subject: Scheduling/Runcutting/Dispatching - Regular Transit
Submitted by: Centre de Recherche sur les transports

Project Title: Enhancements to the HASTUS System

Title of Report: Several Publications

Funding Source(s) and % Share: CTCUM, (75%)/CRSNG, (25%)

Consultants/Contractors Used: -

Total Project Cost: (all years) N.A. Total Project Cost: (1983 only) $60,000

Start Date: 1974 Completion Date: Ongoing

Project Manager: Jean-Marc Rousseau, (514) 343-7575

Dissemination of Results: C.R.T.'s publications, HASTUS is available through GIRO Inc.

Project Objective, Scope, Background, and Methodology:

HASTUS is a set of programs for vehicle and crew scheduling in transit. It has been successfully implemented in several transit organizations in Canada and abroad. HASTUS has been developed at the C.R.T. and is now marketed by GIRO Inc. The activities carried on by the CRT in this area are directed toward improvement and extension to the current system. It includes work on the impacts and interaction of bus scheduling on crew scheduling, assignment of bus lines to garage, work on matching algorithms for crew scheduling, etc.

Project Results/Conclusions/Preliminary Findings:

Several improvements have been achieved and are documented in "Enhancements to the HASTUS System" published in 1983 Workshop on Vehicle and Crew Scheduling.

Further Research Work Identified:

Additional related problems are identified on a continuous basis with CTCUM.

Project Number: 154
Subject: Scheduling/Runcutting/Dispatching - Regular Transit
Submitted by: OC Transpo

Project Title: Automated Runcut Implementation

Title of Report: None

Funding Source(s) and % Share: Ontario Ministry of Transportation and Communications, (100%)

Consultants/Contractors Used: Sage Management Consultants

Total Project Cost: (all years) $50,000 Total Project Cost: (1983 only) -

Start Date: - Completion Date: -

Project Manager: Hugh Wallace, Sage Management Consultants/Joel Koffman, OC Transpo

Dissemination of Results: Results available upon request

Project Objective, Scope, Background, and Methodology:

To replace the manual runcut with a computerized version making use of the computer schedule database.

Project Results/Conclusions/Preliminary Findings:

Results to date (have been using the automated runcut in production use since the December 1983 booking) include: 1) A 50% time saving in man hours; 2) A report condusive database.

Further Research Work Identified:

Project Number: 155
Subject: Scheduling/Runcutting/Dispatching - Regular Transit
Submitted by: OC Transpo

Project Title:	Mini-scheduler Interline Blocking Enhancement
Title of Report:	None
Funding Source(s) and % Share:	OC Transpo, (100%)
Consultants/Contractors Used:	Sage Management Consultants
Total Project Cost: (all years)	$3,000
Total Project Cost: (1983 only)	-
Start Date:	March 1983
Completion Date:	July 1983
Project Manager:	J. Koffman, OC Transpo, (613) 741-6440
Dissemination of Results:	Results available upon request

Project Objective, Scope, Background, and Methodology:

To expand the arcing capabilities of the mini-scheduler BSOLVE in order to provide more potential hooks from one trip to another thus utilizing fewer vehicles. To enable schedulers to ask the system to investigate possible connections, to take into account deadheads, and to see if vehicles could be better allocated to improve service.

Project Results/Conclusions/Preliminary Findings:

Bus saving of 2.3% has resulted from implementation of upgraded scheduling package.

Further Research Work Identified:

Project Number: 156
Subject: Scheduling/Runcutting/Dispatching - Regular Transit
Submitted by: OC Transpo

Project Title: TOB (Timekeeping Operator Booking) System

Title of Report: None

Funding Source(s) and % Share: Ontario Ministry of Transportation and Communications, (100%)

Consultants/Contractors Used: Teleride/Sage

Total Project Cost: (all years) $200,000

Total Project Cost: (1983 only) -

Start Date: January 1984

Completion Date: October 1984

Project Manager: -

Dissemination of Results: -

Project Objective, Scope, Background, and Methodology:

The objective of the TOB project is to develop an automated and integrated Timekeeping Operator Booking (bidding) system. The system will pass Rucus runcut files from the Planning Department to the Operator Booking System, provide automated quarterly signup and daily operator bidding functions as well as interface to the Operator Timekeeping System. The Timekeeping System will provide for the automated production of payhours and interface to existing Payroll/Personnel systems.

Project Results/Conclusions/Preliminary Findings:

Further Research Work Identified:

Project Number: 157
Subject: Scheduling/Runcutting/Dispatching - Disabled Transit
Submitted by: Ontario Ministry of Transportation and Communications/Toronto Transit Commissinn

- -

Project Title: Computer Assisted Scheduling - Wheel-Trans

Title of Report: Not known

Funding Source(s) and % Share: Ontario Ministry of Transportation and Communications, (90%)/Toronto Transit Commission, (10%)

Consultants/Contractors Used: GIRO (Montreal)

Total Project Cost: (all years) $540,000 Total Project Cost: (1983 only) $75,000

Start Date: February 1983 Completion Date: 1985

Project Manager: Mike Cautillo, MTC/A. Hewson, TTC

Dissemination of Results: MTC/TTC/to be determined

- -

Project Objective, Scope, Background, and Methodology:

To provide computer assisted scheduling and passenger reservation for TTC's Wheel-Trans service. In 1980, MTC sponsors U. of T/York Joint Program in Transportation report on computer aided scheduling. Major recommendation is to implement computer system in four phases: Phase I - Management Information System; Phase II - Scheduling Aids; Phase III - Communications Aids; Phase IV - Public Videotex Interface.

- -

Project Results/Conclusions/Preliminary Findings:

Hardware and software installed for testing in February 1984. System operational in May 1984. No results available.

- -

Further Research Work Identified:

Project Number:	158
Subject:	Scheduling/Runcutting/Dispatching - Disabled Transit
Submitted by:	Gandalf Data Ltd.

Project Title: Zonal Dispatch System

Title of Report: None

Funding Source(s) and % Share: Gandalf Data Ltd.

Consultants/Contractors Used: None

Total Project Cost: (all years)	-	Total Project Cost: (1983 only)	-
Start Date:	September 1983	Completion Date:	September 1984

Project Manager: John Seymour, Gandalf Data Ltd., (613) 225-0565

Dissemination of Results: Internal

Project Objective, Scope, Background, and Methodology:

Development of a commercial dispatching system product line suitable for zone-based dispatching systems. Although designed primarily for the taxi industry, it will have application to Dial-A-Ride and/or transportation of the handicapped.

Project Results/Conclusions/Preliminary Findings:

On schedule.

Further Research Work Identified:

None.

Project Number: 159
Subject: Scheduling/Runcutting/Dispatching - Disabled Transit
Submitted by: Transports Adapté du Québec Métro Inc.

Project Title: Computerized Reservation and Scheduling System for Disabled Transit Operations

Title of Report: Computerized Reservation and Scheduling System for Disabled Transit Operations

Funding Source(s) and % Share: Quebec Ministry of Transport, (75%)/CTCUQ, (25%)

Consultants/Contractors Used: Systemoid Inc.

Total Project Cost: (all years) $35,000   Total Project Cost: (1983 only) $7,200

Start Date: December 1983   Completion Date: December 1984

Project Manager: Michel Wilson, Transports Adapté du Québec Métro Inc.

Dissemination of Results: -

Project Objective, Scope, Background, and Methodology:

After a detailed study of operations by a consulting firm, a recommendation will be made as to what kind of computer will handle our daily operation such as: data on user, reservation, accounting system, scheduling and dispatch. Project cost includes computer hardware and software.

Project Results/Conclusions/Preliminary Findings:

The implementation of a computer will eliminate most of the paperwork and will simplify daily operations. Also hope to improve scheduling and dispatch work.

Further Research Work Identified:

None.

Project Number: 160
Subject: Scheduling/Runcutting/Dispatching - Disabled Transit
Submitted by: Centre de Recherche sur les transports

Project Title: Transportation of the Handicapped

Title of Report: N/A

Funding Source(s) and % Share: Transportation Development Centre, (80%)/Hautes Etudes Commerciales, (10%)/C.R.S.N.G., F.C.A.C., (10%)

Consultants/Contractors Used: -

Total Project Cost: (all years) $60,000

Total Project Cost: (1983 only) $25,000

Start Date: May 1983

Completion Date: April 1986

Project Manager: François Soumis, (514) 343-7575

Dissemination of Results: TDC Research Report publication in Scientific Magazines

Project Objective, Scope, Background, and Methodology:

Utilization of vehicles can be increased by letting isolated customers use taxis and by making the transfer in the following way: In each region, a mini-bus picks up the customers even if they have different destinations. These mini-buses present themselves at the same time in a transfer centre, exchange passengers by grouping them by destination. Want to develop algorithms using mathematical programming to construct routes with and without transfers and for the distributing of passengers between taxis and mini-buses with and without transfers.

Project Results/Conclusions/Preliminary Findings:

Have developed optimal algorithms for routes of one vehicle transporting a group of disabled and for routes of several vehicles transporting a group of passengers towards the transfer centre. Have also developed a heuristic algorithm using mathematical programming for routes of several vehicles without transfers. This algorithms improves the solutions by 10 or 20% compared to the heuristic algorithms with parallel insertion that are now used.

Further Research Work Identified:

Will be developing an algorithm for the distributing between 3 modes and will be evaluating scenarios having different locations of transfers centres and different distributing policies between the 3 modes.

Numéro du Projet 160
Sujet: Scheduling/Runcutting/Dispatching-Disabled Transit
Soumis par: Centre de Recherche sur les Transports

Titre du projet:	Transport des handicapés		
Titre du rapport:	-		
Source de financement et Pourcentage des coûts défrayés par chaque organisme:	Transports Canada, (80%)/Hautes Études Commerciales, (10%)/C.R.S.N.G., F.C.A.C., (10%)		
Consultants/Sous-traitants:	-		
Coût total: (toutes les années)	$60,000	Coût total du projet: (1983 seulement)	$25,000
Le projet débute le:	Mai 1983	Fin du projet:	Avril 1986
Directeur du projet:	François Soumis, (514) 343-7575		
Dissémination des résultats:	Rapports de recherche du Centre de recherche sur les transports, publications dans des revues scientifiques		

But, étendue, antécédents et méthodologie du projet:

Le remplissage des véhicules peut être augmenté en laissant les clients isolés aux taxis et en réalisant des correspondances de la façon suivante. Dans chaque région, un minibus ramasse les clients même s'ils ont des destinations différentes, ces minibus se présentent en même temps à un centre de correspondance, échangent les passagers en les regroupant par région de destination et, pour chaque région, un véhicule transporte les clients à destination. Nous proposons de développer des algorithmes utilisant la programmation mathématique pour la fabrication de routes avec et sans correspondance et pour le partage entre les taxis et les transports par minibus avec et sans correspondance.

Résultats/Conclusions/Résultats préliminaires:

Nous avons développé des algorithmes optimaux pour routes de un véhicule transportant un groupe d'handicapés et pour routes de plusieurs véhicules transportant un groupe de clients vers le centre de correspondance. Nous avons également dévelopé un algorithme heuristique utilisant la programmation mathématique pour routes de plusieurs véhicules sans correspondance. Cet algorithme améliore de 10% à 20% les solutions obtenues avec les algorithmes heuristiques d'insertion parallèle actuellement utilisés.

Travail de recherche additionnel identifié:

Nous développerons un algorithme pour le partage entre les trois modes et évaluerons des scénarios de localisation des centres de correspondance et des politiques de partage entre les trois modes.

Project Number:	161
Subject:	Scheduling/Runcutting/Dispatching - Disabled Transit
Submitted by:	Centre de Recherche sur les transports

- -

Project Title:	Scheduling Constraints for Bus Routes		
Title of Report:	Optimal Urban Bus Routing with Scheduling Flexibility		
Funding Source(s) and % Share:	C.R.S.N.G., (50%)/Hautes Etudes Commerciales, (50%)		
Consultants/Contractors Used:	-		
Total Project Cost: (all years)	$20,000	Total Project Cost: (1983 only)	$5,000
Start Date:	May 1981	Completion Date:	November 1983
Project Manager:	François Soumis, (514) 343-7575		
Dissemination of Results:	Proceedings 11th IFIP, Conference Research Report		

- -

Project Objective, Scope, Background, and Methodology:

Developed an optimal algorithm to build routes for buses having to make a series of runs. A run is an itinerary which must be made by one bus. It is characterized by an origin, a destination, a length of time, and must start within a time interval. Its precise schedule is to be determined. A route is a series of runs that are made by one bus. The method finds routes that allow for the beginning of each run in the requested time interval. These routes are optimal in respect to a cost function which includes the number of vehicles and the deadhead and waiting times required.

- -

Project Results/Conclusions/Preliminary Findings:

The algorithm allows the findings of optimal solutions in less than 30 seconds. (optimal solution = optimal no. of buses + optimal cost) for two cities having 128 and 158 runs each. With time intervals of 0-2-4 minutes and some of 10-12 minutes, the algorithm has permitted a reduction of 2% in the number of vehicles and costs, comparatively to an optimal schedule for the same runs with fixed hours.

- -

Further Research Work Identified:

Continuing the development to handle problems with several hundreds of runs and with larger time intervals.

Numéro du Projet	161
Sujet:	Scheduling/Runcutting/Dispatching-Disabled Transit
Soumis par:	Centre de Recherche sur les Transports

Titre du projet:	Routes avec contraintes d'horaires		
Titre du rapport:	Optimal Urban Bus Routing with Scheduling Flexibilities		
Source de financement et Pourcentage des coûts défrayés par chaque organisme:	C.R.S.N.G. (50%)/Hautes Études Commerciales, (50%)		
Consultants/Sous-traitants:	-		
Coût total: (toutes les années)	$20,000	Coût total du projet: (1983 seulement)	$5,000
Le projet débute le:	Mai 1981	Fin du projet:	Novembre 1983
Directeur du projet:	François Soumis, (514) 343-7575		
Dissémination des résultats:	Rapport de recherche H.E.C., G-83-33, Proceedings 11th IFIP Conference		

But, étendue, antécédents et méthodologie du projet:

Nous avons développé un algorithme optimal pour construire des routes d'autobus devant effectuer un ensemble de parcours. Un parcours est un itinéraire qui doit être effectué par un même autobus. Il est caractérisé par une origine, une destination, une durée et doit débuter dans un intervalle de temps; son horaire exact est à déterminer. Une route est une suite de parcours qu'effectue un même autobus. La méthode développée trouve des routes commençant chaque parcours dans l'intervalle de temps imposé; ces routes sont optimales suivant une fonction de coût intégrant le nombre de véhicules, les distances de déplacement à vide et le temps d'attente hors du dépôt.

Résultats/Conclusions/Résultats préliminaires:

L'algorithme développé a permis de trouver des solutions optimales en moins de 30 secondes, pour le nombre d'autobu et le coût pour des problèmes de deux villes ayant 128 et 158 parcours. Avec des intervalles de temps de 0-2-4 minutes et quelques uns de 10-12 minutes, l'algorithme a permis une réduction de l'ordre de 2% du nombre de véhicules et des coûts par comparaison avec un horaire optimal pour les mêmes parcours à heures fixes.

Travail de recherche additionnel identifié:

Nous poursuivrons le développement pour traiter des problèmes de plusieurs centaines de parcours et avec des intervalles de temps plus larges.

Project Number:	162		
Subject:	Scheduling/Runcutting/Dispatching - Disabled Transit		
Submitted by:	Transport Canada/Roads and Transportation Association of Canada/Centre de Recherche sur les transports		

- -

Project Title:	Software Development for Disabled Transit		
Title of Report:	Not available		
Funding Source(s) and % Share:	Transportation Development Centre, (58%)/Roads and Transportation Association of Canada, (42%)		
Consultants/Contractors Used:	Centre de Recherche sur les transports		
Total Project Cost: (all years)	$120,000	Total Project Cost: (1983 only)	$66,000
Start Date:	July 12, 1982	Completion Date:	-
Project Manager:	S. Corbeil/L. Parent, (514) 283-4100		
Dissemination of Results:	Distribution to interested disabled transit operators		

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Project Objective, Scope, Background, and Methodology:

Project is aimed at improving accessibility of national transporation for disabled persons. More specifically to build software package for the controlling and dispatching of mini-buses for disabled transit. The purpose of the project is to build a computerized system which will produce mini-bus schedules in a precise order to ensure improved service, lower cost and more appropriate service to meet user needs. The system includes graphic displays - colors of routes on the computer.

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Project Results/Conclusions/Preliminary Findings:

To date, results are excellent. Being still in testing phase, it is too early to assess results, but they seem to be very valuable and of great use to interested agencies.

- -

Further Research Work Identified:

Improvement of color display on computer.

Numéro du Projet	162
Sujet:	Scheduling/Runcutting/Dispatching-Disabled Transit
Soumis par:	TC/RTAC/Centre de recherche sur les transports

- -

Titre du projet:	Logiciel pour le transport des handicapés		
Titre du rapport:	Pas encore disponible		
Source de financement et Pourcentage des coûts défrayés par chaque organisme:	CDT, (58%)/RTAC, (42%)		
Consultants/Sous-traitants:	Centre de recherche sur les transports, Université de Montréal		
Coût total: (toutes les années)	$120,000	Coût total du projet: (1983 seulement)	$66,000
Le projet débute le:	12 juillet, 1982	Fin du projet:	31 août, 1984
Directeur du projet:	S. Corbeil/L. Parent, (514) 283-4100		
Dissémination des résultats:	Distribution du rapport aux organismes de transport pour les handicapés		

- -

But, étendue, antécédents et méthodologie du projet:

Améliorer l'accessibilité du système de transport national pour les personnes handicapées. Construire un logiciel pour le contrôle et l'affectation des minibus pour le transport des personnes handicapées. Le projet vise la construction d'un système informatisé qui fabriquera des horaires de minibus selon un ordre précis de façon à assurer un meilleur service, plus économique et approprié aux besoins des usagers. Le système comprend également la représentation graphique - couleurs des parcours sur ordinateur.

- -

Résultats/Conclusions/Résultats préliminaires:

Jusqu'à date, les résultats sont excellents. Étant encore à l'étude des tests, il est encore trop tôt pour porter des ugements définitifs sur les résultats. Cependant, il semble qu'ils seront très valables et d'une grande utilité aux organismes concernés.

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Travail de recherche additionnel identifié:

Perfectionnement des représentations graphiques couleurs sur ordinateur.

Project Number: 163
Subject: Scheduling/Runcutting/Dispatching - Disabled Transit
Submitted by: BC Transit

Project Title: Micro-Computer Applications in Custom Transit Services

Title of Report: 1) Investigation of the Opportunities for Improvements in Custom Transit
2) Current and Future System Solutions for BC Transit

Funding Source(s) and % Share: BC Transit/Victoria Regional Transit Commission, (100%)

Consultants/Contractors Used: None

Total Project Cost: (all years) $20,000 — Total Project Cost: (1983 only) -

Start Date: - — Completion Date: March 1984

Project Manager: J. Boehmer, BC Transit, (604) 385-2551

Dissemination of Results: -

Project Objective, Scope, Background, and Methodology:

The overall objective of the project is to improve the efficiency, effectiveness, and economy of Custom Transit operations. More specifically, the application of micro-computer technology to Custom Transit Operations was investigated. This project includes several different stages: 1) To investigate present operational and administrative methods utilized in Custom Transit Operation, identify problems, and investigate opportunities for computer assisted improvements; 2) A definition of the functional specifications for a computer-aided scheduling system; 3) Client registration, booking of trips, and printing vehicle trip sheets; 4) Monthly statistics system.

Project Results/Conclusions/Preliminary Findings:

Time savings in a number of operations including: client registration; client booking time; preparation of vehicle trip logs; preparation of monthly stats. Improved accuracy of: statistics; client information.

Further Research Work Identified:

Further evaluation of benefits required; use of computer to provide summary information for manual scheduling.

Project Number:	164
Subject:	Scheduling/Runcutting/Dispatching - Disabled Transit
Submitted by:	BC Transit

Project Title: Data Collection & Analysis for Custom Transit Operations

Title of Report: None

Funding Source(s) and % Share: BC Transit, (100%)

Consultants/Contractors Used: Student Computer Studies - Camosun College

Total Project Cost: (all years) $1,400

Total Project Cost: (1983 only) -

Start Date: February 1983

Completion Date: January 1984

Project Manager: J. Boehmer, BC Transit, (604) 385-2551

Dissemination of Results: -

Project Objective, Scope, Background, and Methodology:

Due to the large quantity of data generated by Custom Transit operations (in B.C. from 400 - 800 one-way trips per week/system) the use of the computer was identified to improve both the speed and the accuracy of data analysis. Objective was to develop a system of gathering and analyzing data for custom/paratransit operations. The project includes the design of a trip log sheet to record data and a computer program to output a variety of statistics. Trip logs are distributed periodically to drivers. The data is then keyed in and 8 programs are run. The programs are in Fortran. Input is information from trip log sheet. Travel Times, Trip Lengths, Trip Frequency by User, Deadheading, Trip Purpose by Time of Day, Trips on Vehicle, Day, and Time of Day, Schedule Adherence and Trips by Zone.

Project Results/Conclusions/Preliminary Findings:

Increased accuracy of results, significant reduction in time, improved feedback to operators on system performance, aid to generation of service alternatives/modifications, sources of error remain in the consistency and accuracy of data recording by drivers and data input errors. See Appendix IV for a sample trip log sheet.

Further Research Work Identified:

Project Number: 165
Subject: Fuel Management
Submitted by: Corporation intermunicipale de transport du Saguenay

Project Title: Control of Fuel Consumption and Inventory

Title of Report: -

Funding Source(s) and % Share: Corporation intermunicipale de transport du Saguenay, (100%)

Consultants/Contractors Used: Upsilon D.B. Inc.

Total Project Cost: (all years)	-	Total Project Cost: (1983 only)	-
Start Date:	January 1983	Completion Date:	May 1983

Project Manager: Bernard Brassard, 545-3683

Dissemination of Results: -

Project Objective, Scope, Background, and Methodology:

The objective was to automate data acquisition and management with respect to fuel consumption and inventory. Daily fuel usage by vehicle, kilometres travelled, security at fuel pumps, unlimited access to data, and vehicle inspection intervals were project requirements. An interface between the fuel pumps and CITS' IBM 34 computer was required. Specific employee code numbers were assigned to the operators.

Project Results/Conclusions/Preliminary Findings:

System is in and working. It generates data on time, employee number, vehicle, odometer reading, pump number, litres, distance travelled and litres per 100 k. Daily summaries and inventory controls are also printed out by the computer.

Further Research Work Identified:

Numéro du Projet 165
Sujet: Fuel Management
Soumis par: Corporation Intermunicipale de transport de Saguenay

- -

Titre du projet:	Contrôle de la Consommation et des inventaires de carburant		
Titre du rapport:	-		
Source de financement et Pourcentage des coûts défrayés par chaque organisme:	Corporation Intermunicipale de transport de Saguenay, (100%)		
Consultants/Sous-traitants:	Upsilon D.B. Inc.		
Coût total: (toutes les années)	-	Coût total du projet: (1983 seulement)	-
Le projet débute le:	Janvier 1983	Fin du projet:	Mai 1983
Directeur du projet:	Bernard Brassard, 545-3683		
Dissémination des résultats:	-		

- -

But, étendue, antécédents et méthodologie du projet:

L'objectif du projet était d'automatiser l'acquisition et la gestion des données de consommation d'essence et de réserves d'essences. La consommation journalière pour chaque véhicule, le nombre de kilomètres parcourus, la sécurité aux pompes, l'accès illimité aux données et les intervalles entre les inspections des véhicules étaient toutes des exigences que le projet avait à satisfaire. Un interface entre les pompes à essence et l'ordinateur IBM 34 de la CITS était nécéssaire. Un numéro d'employé individuel fut remis à chaque chauffeur.

- -

Résultats/Conclusions/Résultats préliminaires:

Le système est implanté et fonctionne. Les données suivantes sont émises: le temps, le no. d'employé, le véhicule, le kilométrage, le no. de la pompe, le nombre de litres, la distance parcourue, et la consommation d'essence aux 100 km. Des rapports sommaires et un contrôle d'inventaire sont aussi produits quotidiennement par l'ordinateur.

- -

Travail de recherche additionnel identifié:

Project Number:	166
Subject:	Fuel Management
Submitted by:	Metro Transit Commission - Halifax

Project Title: Energy Management

Title of Report: Energy Management with a Programmable Controller

Funding Source(s) and % Share: Metro Transit Commission, (100%)

Consultants/Contractors Used: Canadian British Consultants Limited

Total Project Cost: (all years) $10,000 Total Project Cost: (1983 only) $2,000

Start Date: March 1, 1983 Completion Date: Ongoing

Project Manager: Jim Carrick, Metro Transit Commission, (902) 421-6600

Dissemination of Results: In-house report to Metro Transit Commission, report available from CUTA Library

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Project Objective, Scope, Background, and Methodology:

The Metropolitan Transit garage, when constructed, had a programmable controller installed. This was done to help control electrical energy costs and to perform simple on/off control for large electrical equipment within the building. Since installation, there has been several programme changes done within the controller to help in reducing the electrical bill. There also have been several pieces of equipment added since installation to reduce electrical consumption. The programmable controller is a dedicated micro-computer used to turn on/off electrical and monitor power consumption or circuit conditions. The controller is able to have its programme (software) changed by entering numerical information via a special terminal. The programme is easily changed to accommodate changes in operating conditions within the transit garage. All pieces of the controller are located within the shift foreman's office and is hard wired back to the equipment under its control. The purpose of the report is to make non-technical staff and commission members aware of the accomplishments that could and are being performed by the use of programmable controllers and to further reduce and stabilize power consumption with the programmable controller.

Project Results/Conclusions/Preliminary Findings:

The rates charged by the Nova Scotia Power Commission and the government assistance rates have changed considerably since start-up of the garage. The total increase in rates for electricity charged to the consumer has risen approximately 30% to 35%. No increase in monthly bills have occurred. When all the power bills are calculated using the same charges, a reduction of 11% in electrical billing is seen. All savings in electrical costs are attributable to the workings of the programmable controller since there has been no real change in the operation of the garage.

Further Research Work Identified:

Project Number: 167
Subject: Traffic Control Systems
Submitted by: Pannell Kerr Forster Ltd.

Project Title: Traffic Checking System

Title of Report: Traffic Checking System

Funding Source(s) and % Share: BC Transit, (100%)

Consultants/Contractors Used: Pannell Kerr Forster Ltd.

Total Project Cost: (all years) $130,000 — Total Project Cost: (1983 only) -

Start Date: June 1981 — Completion Date: March 1982

Project Manager: G. Tiller, (604) 688-8666

Dissemination of Results: Metro Transit Operating Company, BC Transit

Project Objective, Scope, Background, and Methodology:

The Traffic Check Analysis Computer System is designed to store and subsequently to analyze an assortment of actual traffic check data against computerized transit system scheduled data. The traffic check and corresponding schedule data can be used in a variety of different ways by manipulating a number of schedule characteristics variables (eg. route, run, time, location, etc.) to produce automated analysis reports. These reports provide insight about the effectiveness and efficiency of the schedule transit system operations to the schedule analysis team. The reports are subsequently used to make recommendations to adjust transit schedules in a continuing effort to improve the performance of the transit system.

Project Results/Conclusions/Preliminary Findings:

The system has been in operation for two years. The system has proven to be very reliable with a high degree of user satisfaction. The system has virtually eliminated many of the tedious and time consuming tasks such as: manual transcription of field data, manual matching of actual to scheduled data; verification of summary reports, manual transcription, summarization and analysis to produce management reports. Analyst time available to perform actual analysis has doubled in most cases.

Further Research Work Identified:

The system currently handles primarily point check data. Future enforcements would include the capability to efficiently handle ride check data and data collected by automatic passenger counting devices.

Project Number: 168
Subject: Traffic Control Systems
Submitted by: National Research Council

Project Title: Urban Traffic Control System

Title of Report: Not known

Funding Source(s) and % Share: National Research Council, (51.8%)/Canadian General Electric Company Ltd. (48.2%)

Consultants/Contractors Used: Canadian General Electric Company Ltd.

Total Project Cost: (all years) $1,510,000
Total Project Cost: (1983 only) $320,000

Start Date: March 8, 1982
Completion Date: June 30, 1984

Project Manager: D.W. Laurie-Lean

Dissemination of Results: Results to be used by company in capturing Canadian and foreign markets

Project Objective, Scope, Background, and Methodology:

Company has purchased world rights to R & D of a U.S. Computer-Based Traffic Control System. Company has orders on hand but needs funds to support additional development. Company is only Canadian company in this field. Funding contribution will increase Canadian content. The system will reduce traffic idle time with resultant fuel economies and reduction of air pollution.

Project Results/Conclusions/Preliminary Findings:

Thus far CGE have installed computer controlled traffic systems in approximately six Ontario towns, and cities. These have been working very successfully thus far. The technology transfer portion of the project is to do with a computer model simulation (generalized) of a computer controlled traffic system.

Further Research Work Identified:

The only pressing further work (research) that needs attention is in connection with the above-mentioned model (simulation) eg. specifications of the problem and the employment of queuing theory and modelling analysis. This is currently underway.

Project Number: 169
Subject: Traffic Control Systems
Submitted by: Quebec Ministry of Transport

Project Title: Signalling Systems

Title of Report: Signalling Systems for the Preferential Treatment of Vehicles with High No. of Passengers

Funding Source(s) and % Share: Quebec Ministry of Transport, (100%)

Consultants/Contractors Used: Canatrans Consulting

Total Project Cost: (1981-84) $50,000
Total Project Cost: (1983 only) $19,000

Start Date: 1982
Completion Date: June 1982

Project Manager: Nguyen Quang Quy, (418) 643-1675

Dissemination of Results: -

Project Objective, Scope, Background, and Methodology:

Project objective is to recommend to the Quebec normalising committee, a signalling system for the preferential treatment of high occupancy vehicles. A sample of models used elsewhere was made. A visibility and comprehension analysis was undertaken.

Project Results/Conclusions/Preliminary Findings:

The evaluation of existing models has allowed us to find what signalling system was preferable.

Further Research Work Identified:

Numéro du Projet	169		
Sujet:	Traffic Control Systems		
Soumis par:	Ministère des Transports du Québec		

Titre du projet:	Systèmes de Signalisation		
Titre du rapport:	Systèmes de signalisation pour le traitement préférentiel des véhicules à taux d'occupation élevé		
Source de financement et Pourcentage des coûts défrayés par chaque organisme:	Ministère des Transports du Québec, (100%)		
Consultants/Sous-traitants:	Canatrans		
Coût total: (1983-84)	$50,000	Coût total du projet: (1983 seulement)	$19,000
Le projet débute le:	1982	Fin du projet:	Juin 1984
Directeur du projet:	Nguyen Quang Quy, (418) 643-1675		
Dissémination des résultats:	-		

But, étendue, antécédents et méthodologie du projet:

En vue de recommander au comité de normalisation du Québec le système de signalisation à mettre en oeuvre pour le traitement préférentiel des véhicules collectifs, une cueillette des modèles utilisés ailleurs a été entreprise. Une analyse de visibilité et de compréhension a été faite.

Résultats/Conclusions/Résultats préliminaires:

L'évaluation des modèles existants a permis de choisir le type de signalisation à privilégier.

Travail de recherche additionnel identifié:

Project Number:	170
Subject:	Traffic Control Systems
Submitted by:	Transportation Development Centre

Project Title: SSTOP Micro Computer Version

Title of Report: None

Funding Source(s) and % Share: Transportation Development Centre, (100%)

Consultants/Contractors Used: Ontario Ministry of Transportation and Communications

Total Project Cost: (all years)	$15,000	Total Project Cost: (1983 only)	$3,000
Start Date:	March 1, 1984	Completion Date:	August 1, 1984

Project Manager: Catherine Hirou, (514) 283-4072

Dissemination of Results: Diskette, user's guide, final report limited supply of final reports for distribution from TDC

Project Objective, Scope, Background, and Methodology:

To provide an opportunity to all potential users to benefit from the SSTOP package by making it available on a micro-computer, thereby facilitating a wide spread use of this powerful tool. This project will fulfill the need expressed by Canadian traffic engineers for a micro-computer version of the current SSTOP package. As the present program is based on a 32 bit word structure, substantial analysis and reprogramming is needed to make the package compatible with the 8 bit word size of a micro-computer. The new version will be tested and evaluated, it will be available for use on the IBM PC, APPLE II, ZENITH as well as the OSBORNE.

Project Results/Conclusions/Preliminary Findings:

Not yet available.

Further Research Work Identified:

Project Number:	171
Subject:	General Computer Applications
Submitted by:	Canadian Urban Transit Association

- -

Project Title:	Microelectronics and Urban Transit		
Title of Report:	Microelectronics and Urban Transit		
Funding Source(s) and % Share:	Transportation Development Centre, (100%)		
Consultants/Contractors Used:	TransVision Consultants in cooperation with CUTA		
Total Project Cost: (all years)	$3,000	Total Project Cost: (1983 only)	-
Start Date:	January 1984	Completion Date:	March 1984
Project Manager:	L. Suen, (514) 283-4082		
Dissemination of Results:	Limited number of copies available from TDC and CUTA		

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Project Objective, Scope, Background, and Methodology:

Microelectronics, through the new information technologies and the microprocessor, are being introduced into many different areas of society for storing, manipulating, and communicating information. At the same time, information-related activities are becoming more important with the result that the technology is expanding at an ever-increasing pace. The adoption and rate of diffusion of microelectronic technology in the urban transit industry in Canada is extremely diverse. The Canadian Urban Transit Association and Transportation Development Centre recognized that there was a growing dichtomy between those systems/persons who understand the nature and workings of the technology and those that do not. A small project was initiated to stimulate discussion within government and the transit industry of the applications, impediments, and applications of microelectronics. As well this project was intended to document the current state-of-the-art, the application of microelectronics in the urban transit industry for information, communications, and control functions. The primary method of data collection was a literature review and contacts with selected suppliers and users. The results of a CUTA questionnaire on computer application in the transit industry was used as a reference document.

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Project Results/Conclusions/Preliminary Findings:

There are several key technologies underlying the application of microelectronics in urban transit. These technologies are complex and new hardware and software is continually evolving. The possible applications are extremely diverse although the awareness of these products within the industry and the ability to adopt and adjust to the new technology is constrained.

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Further Research Work Identified:

Project Number:	172
Subject:	General Computer Applications
Submitted by:	Canadian Urban Transit Association

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Project Title: Computer Applications - Questionnaire 83-8

Title of Report: Current Status and Future Development of Computer Application

Funding Source(s) and % Share: Canadian Urban Transit Association, (100%)

Consultants/Contractors Used: None

Total Project Cost: (all years) -

Total Project Cost: (1983 only) -

Start Date: November 1983

Completion Date: March 1984

Project Manager: C. Wheeler, Canadian Urban Transit Association, (416) 365-9800

Dissemination of Results: Results available from CUTA

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Project Objective, Scope, Background, and Methodology:

Over the past decade, transit systems have made increasing use of computer applications and have gone beyond traditional computer uses for accounting and payroll functions. Transit operators across Canada now use computers of various sizes for scheduling, runcutting, vehicle assignment, materials management, vehicle maintenance, passenger information, operating statistics, etc. However, the adoption of computer technology in the transit industry has been diverse, and information dissemination and exchange has, in the past, been limited. As a result, a questionnaire was designed to obtain an overview of the current computer facilities, the current uses of computer, future plans in the area of computer applications, and the information used to justify the use of computers within the transit industry. The questionnaire was approved by the CUTA Sub-Committee on Computer Applications and distributed to all CUTA operating members.

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Project Results/Conclusions/Preliminary Findings:

A total of 50 operating members responded to the questionnaire. Computer applications within the transit industry are widespread but are primarily administrative in nature. In terms of administrative functions, the highest percentage of computer applications was for general ledger and budgeting functions. In terms of operations, computer applications were used most commonly for scheduling, runcutting, and the recording of absenteeism statistics. A large number of transit systems expect to convert operational functions which are currently done manually to computers within the next three years including timekeeping, absenteeism records, and scheduling. The use of computers for planning and monitoring is still limited although a large number of systems are planning to computerize passenger counting and performance monitoring functions within three years. A high level of computerization is planned for materials management and vehicle maintenance within three years especially for small and medium sized systems. The use of computers for marketing and passenger information is expected to increase, however, the vast majority of respondents do not anticipate using computers for this function within three years. CUTA has a significant role to play in assisting small and medium sized systems, providing the industry with state-of-the-art information, educating transit management, and promoting the development of transit specific software.

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Further Research Work Identified:

CUTA Sub-Committee on Computer Applications is currently considering a number of activities which could lead to R & D projects being recommended to the R & D Coordinating Committee.

Project Number:	173
Subject:	General Computer Applications
Submitted by:	Ontario Ministry of Transportation and Communications

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Project Title:	Computers in the Transit Industry		
Title of Report:	Not known		
Funding Source(s) and % Share:	Ontario Ministry of Transportation and Communications, (100%)		
Consultants/Contractors Used:	Group Five Consulting Ltd.		
Total Project Cost: (all years)	$20,000	Total Project Cost: (1983 only)	-
Start Date:	March 1984	Completion Date:	May 1984
Project Manager:	Mike Cautillo, MTC, (416) 248-3785		
Dissemination of Results:	To be determined		

Project Objective, Scope, Background, and Methodology:

Given the large technological improvements that have occurred in the computer area, coupled with a drastic price reduction a large number of transit properties are looking at micro's. This is an attempt to plan policies and strategies. Qjbective is to present an overview of the computer needs during the next five years of small and mid-sized transit operations in Ontario that will assist the Ministry in developing policies and strategies leading to an appropriate and effective use of computers.

Project Results/Conclusions/Preliminary Findings:

Not yet available.

Further Research Work Identified:

Project Number:	174
Subject:	General Computer Applications
Submitted by:	Montreal Urban Transit Commission

Project Title:	Computers at Providence Centre		
Title of Report:	Same as above		
Funding Source(s) and % Share:	Ministry of Transport of Quebec (100%)		
Consultants/Contractors Used:	Sodeteg T.A.I. (Study Only)		
Total Project Cost: (all years)	$5,000,000	Total Project Cost: (1983 only)	$350,000
Start Date:	March 1984	Completion Date:	January 1986
Project Manager:	Jean-Denis Pelletier (514) 877-6077		
Dissemination of Results:			

Project Objective, Scope, Background, and Methodology:

Determine what computer services are needed to implement operating and management techniques with the following objectives: increase effectiveness of operations, minimize deadhead, implement short-turning procedures to delay the purchase of new material, improve analysis of service disruption, increase response time in case of fire, receive information to help respond more efficiently in case of power failure, collect statistics to improve planning of materials purchases and rolling stock maintenance.

Project Results/Conclusions/Preliminary Findings:

No results available.

Further Research Work Identified:

Numéro du Projet 174
Sujet: General Computer Applications
Soumis par: Commission de transport de la Communauté urbaine de Montréal

Titre du projet: Ordinateurs à Providence

Titre du rapport: Idem

Source de financement et pourcentage des coûts défrayés par chaque organisme: Ministère des Transports du Quebec (100%)

Consultants/Sous-traitants: Sodeteg T.A.I. (Etudes seulement)

Coût total: (toutes les années) $5,000,000
Coût total du projet: (1983 seulement) $350,000

Le projet débute le: Mars 1984
Fin du projet: Janvier 1986

Directeur du projet: Jean-Denis Pelletier (514) 877-6077

Dissémination des résultats:

But, étendue, antécédents et méthodologie du projet:

Préciser les besoins de service d'ordinateurs requis pour l'implantation des nouvelles techniques d'exploitation et de gestion avec les objectifs suivants: augmenter l'efficacité des opérations, minimiser les mouvements des trains à vide, exploiter des lignes courtes afin de retarder l'acquisition de nouveau matériel roulant, mieux analyser les perturbations de service, retracer rapidement les mesures prises lors d'incidents antérieurs en ligne, augmenter la rapidité d'intervention en cas d'incendie, recevoir l'information en vue d'intervenir plus efficacement en cas de pannes, accumuler des statistiques en vue de mieux planifier l'entretien des équipements et du matériel roulant.

Résultats/Conclusions/Résultats préliminaires:

Resultats non disponibles.

Travail de recherche additionnel identifié:

Project Number: 175.
Subject: Other Computer Applications
Submitted by: Transport Canada

Project Title: Automatic Stop Announcement System

Title of Report: None

Funding Source(s) and % Share: Transportation Development Centre, (50%)/BTM International, (50%)

Consultants/Contractors Used: BTM International

Total Project Cost: (all years) $160,000

Total Project Cost: (1983 only) $80,000

Start Date: January 15, 1984

Completion Date: -

Project Manager: M. Audette, (514) 283-4064

Dissemination of Results: -

Project Objective, Scope, Background, and Methodology:

Project objective is to increase the quality and quantity of information to transit riders and to improve accessibility to transit facilities for those persons with sight and/or hearing problems. In terms of operational benefits, the system would free vehicle operators from the demands of routine announcements and could also help to reduce station dwell-time. Includes (1) the development of an automatic system for audio and visual announcements of stops in subway trains (2) the construction of a prototype system and operational testing on the Montreal subway system. Prototype will be developed for sale to Canadian transit operators and in other countries.

Project Results/Conclusions/Preliminary Findings:

Further Research Work Identified:

Numéro du Projet 175
Sujet: Other Computer Applications
Soumis par: Transport Canada

Titre du projet: Annonce aux Voyageurs

Titre du rapport: Aucune

Source de financement et Pourcentage des coûts défrayés par chaque organisme: CDT, (50%)/BTM International Inc., (50%)

Consultants/Sous-traitants: BTM International Inc.

Coût total: (toutes les années) $160,000

Coût total du projet: (1983 seulement) $80,000

Le projet débute le: -

Fin du projet: -

Directeur du projet: M. Audette, (514) 283-4064

Dissémination des résultats: -

But, étendue, antécédents et méthodologie du projet:

Augmenter la qualité et la quantité d'information aux usagers des systèmes de transports en commun afin d'améliorer leur accessibilité. Développer un système d'annonce (audio) et d'affichage (visuel) automatique des stations abord des trains de métros ou des banlieues pour préaviser les usagers. Étudier et développer un système d'annonce et d'affichage automatique des stations à bord des trains. Fabriquer un prototype du système et le faire fonctionner sur le réseau existant du métro de Montréal. Développer ce prototype dans le but final de vendre le système sur des réseaux de métros existants au Canada et dans des pays étrangers.

Résultats/Conclusions/Résultats préliminaires:

Travail de recherche additionnel identifié:

Project Number: 176
Subject: Other Computer Applications
Submitted by: Dynamic Sciences Ltd.

Project Title:	Development of a Real Time Digital Train Dynamics		
Title of Report:	Simulation Computer Program		
Funding Source(s) and % Share:	National Research Council/Transportation Development Centre, (100%)		
Consultants/Contractors Used:	Dynamic Sciences Ltd.		
Total Project Cost: (all years)	$376,000	Total Project Cost: (1983 only)	$200,000
Start Date:	April 1983	Completion Date:	-
Project Manager:	R. Mathewson		
Dissemination of Results:	-		

Project Objective, Scope, Background, and Methodology:

The increasing utilization of unit trains and heavier equipment and the application of new operating techniques requires the ability to simulate "in-train" conditions in real-time under various applications in advance of actual operation and for re-creation of train incidents after the fact. Particular emphasis is directed to determining dynamic longitudinal forces at couplers and the longitudinal acceleration on individual cars within the train. DSL is a manufacturer of locomotive enginemen training simulators and the objective of this project is to make the train modelling capability of these simulators as an analytical tool available to others in the industry. It is planned to transfer the software to NRC for its use although the software will continue to be proprietary to Dynamic Sciences Ltd.

Project Results/Conclusions/Preliminary Findings:

Project is proceeding. Conversion of existing hybrid system to full digital real time simulation is advanced. Project to be completed in 1984.

Further Research Work Identified:

Project Number:	177
Subject:	Other Computer Applications
Submitted by:	Dynamic Sciences Ltd.

Project Title:	Development of a Digital Sound Synthesizer for a Locomotive Training Simulator to Realistically Reproduce Cab Sound Under Varying Load Conditions		
Title of Report:	None		
Funding Source(s) and % Share:	Dynamic Sciences Ltd., (100%)		
Consultants/Contractors Used:	-		
Total Project Cost: (all years)	$40,000	Total Project Cost: (1983 only)	$20,000
Start Date:	1982	Completion Date:	-
Project Manager:	Gaston Levesque		
Dissemination of Results:	Held by Dynamic Sciences Ltd.		

Project Objective, Scope, Background, and Methodology:

The CN Rail Training Center at Gimli, Manitoba uses tape decks with a fixed sound pattern to simulate locomotive cab noise. A higher quality variable computer controlled sound system was required to improve the authenticity of the simulator environment. Based on cab sound recordings, a completely realistic sound digital synthesizer was developed, responsive to various throttle and load settings.

Project Results/Conclusions/Preliminary Findings:

The system has been installed at Gimli and is completely successful in its realism under various conditions. A much higher level of reliability as compared with the previous tape system was achieved.

Further Research Work Identified:

Recreation of interior sounds of all types of vehicle training simulators.

Project Number: 178
Subject: Other Computer Applications
Submitted by: Dynamic Sciences Ltd.

- -

Project Title: Development of an Improved Variable Speed 35 MM Motion Picture Projector for Locomotive Training Simulator

Title of Report: -

Funding Source(s) and % Share: Canadian National, (90%)/Dynamic Sciences Ltd., (10%)

Consultants/Contractors Used: Dynamic Sciences Ltd.

Total Project Cost: (all years) $50,000 Total Project Cost: (1983 only) $25,000

Start Date: 1982 Completion Date: 1983

Project Manager: Gaston Levesque

Dissemination of Results: Held by Dynamic Sciences Ltd.

- -

Project Objective, Scope, Background, and Methodology:

The image quality of the 35 mm projector used on the simulators at the CN Rail Training Center at Gimli, Manitoba is unacceptable. The project objective was to develop an improved image quality, higher speed computer controlled projector. Modifications to the SERVO controller for the frame pull down motor were achieved by the design and manufacture of an improved electronic computer controlled system.

- -

Project Results/Conclusions/Preliminary Findings:

Maximum projector speed was raised from 35 to 55 frames per second, achieving both an improved image and a higher level of reliability.

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Further Research Work Identified:

Technique applicable to any variable speed projection system under computer control.

Project Number: 179
Subject: Other Computer Applications
Submitted by: City of Calgary/Calgary Transit

- -

Project Title: Computer Assisted Mapping of Transportation Facilities

Title of Report: Computer Assisted Mapping of Transportation Facilities

Funding Source(s) and % Share: Alberta Transportation, (66%)/City of Calgary, (33%)

Consultants/Contractors Used: City of Calgary's Computer Mapping Information Resource Management Division

Total Project Cost: (all years) $20,000 Total Project Cost: (1983 only) -

Start Date: April 1984 Completion Date: July 1984

Project Manager: Rebecca Somers, Information Resource Management Division, City of Calgary

Dissemination of Results: Calgary Transit, City of Calgary, Alberta Transportation

- -

Project Objective, Scope, Background, and Methodology:

This pilot project is a component of the City of Calgary's Computer Mapping and Geoprocessing Program. The purpose of this particular pilot project is to develop and evaluate procedures for the computer assisted mapping of transportation facilities, the geoprocessing of transportation related data and the creation of a sample data base. Basic objectives: (1) Develop procedures for computer assisted mapping of transportation facilities (2) Create transportation facilities maps and related data bases. Monitor process. (3) Evaluate procedures and resultant data bases and products. (4) Develop cost/benefit analysis for future mapping projects, based on results of this pilot project.

- -

Project Results/Conclusions/Preliminary Findings:

Not yet available.

- -

Further Research Work Identified:

TRANSPORTATION

PLANNING AND MANAGEMENT

Project Number: 180
Subject: Rapid Transit Studies
Submitted by: Toronto Transit Commission

Project Title: Eglinton Rapid Transit Study

Title of Report: Eglinton Rapid Transit Study

Funding Source(s) and % Share: Ontario Ministry of Transportation and Communications, (75%)/Metropolitan Toronto, (25%)

Consultants/Contractors Used: None

Total Project Cost: (all years) $200,000 Total Project Cost: (1983 only) -

Start Date: 1983 Completion Date: 1985

Project Manager: D.J. Morton, Toronto Transit Commission, (416) 481-4252

Dissemination of Results: Public reports

Project Objective, Scope, Background, and Methodology:

Feasibility study for rapid transit line using the Eglinton corridor from Yonge Street to Metro west boundary and beyond. Will address alignment west of Spadina subway, technology required, capacity requirements, an operational plan for feeder bus service, capital and operating costs, and the determination of priority stages and a phased development plan. The study will be undertaken in such a manner as to satisfy the requirements of the Environmental Assessment Act.

Project Results/Conclusions/Preliminary Findings:

N/A

Further Research Work Identified:

N/A

Project Number: 181
Subject: Rapid Transit Studies
Submitted by: Toronto Transit Commission

Project Title: Downtown Rapid Transit Project

Title of Report: Downtown Rapid Transit Project

Funding Source(s) and % Share: Ontario Ministry of Transportation and Communications, (90%)/Metropolitan Toronto, (10%)

Consultants/Contractors Used: None

Total Project Cost: (all years) $500,000 Total Project Cost: (1983 only) $80,000

Start Date: 1983 Completion Date: 1985

Project Manager: D.J. Morton, Toronto Transit Commission, (416) 481-4252

Dissemination of Results: Public reports

Project Objective, Scope, Background, and Methodology:

The 1 ¼ million square metres of office space built in downtown Toronto in the last decade and the 2 million s.m. planned for the next two decades translate into a big increase in the number of downtown office workers. This construction activity has added about 50,000 office workers to the downtown over the past decade and will add space for up to another 80,000 over the next two decades. In addition to office development, a major factor in this increased patronage has been the shift towards transit. In 1975, 68% of the work trips to the Central Area were by transit. By 1983, this had increased to 74% and in the Railway Lands Part II - Concept Report, forecast further shifting of travel from the private automobile to transit. This increase in transit patronage can take place only if the capacity is available. A transit operation analysis carried out in 1982 by the TTC predicted a 1991 demand on the Yonge Subway that would exceed capacity by 7%, and a demand on the University Subway that would be within 13% of capacity for that line. The purpose of the study is to investigate potential alignments and technology options for a downtown relief line to alleviate congestion on the Yonge Street Subway line.

Project Results/Conclusions/Preliminary Findings:

Work is ongoing. No report available.

Further Research Work Identified:

N/A

Project Number: 182
Subject: Rapid Transit Studies
Submitted by: Paterson Planning and Research Ltd.

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Project Title: Land Use/Social Environmental Component of the Mississauga Segment of the Northern Section of the GO-ALRT Program

Title of Report: Not known

Funding Source(s) and % Share: Ontario Ministry of Transportation and Communications, (100%)

Consultants/Contractors Used: Paterson Planning and Research Limited/McCormick Rankin & Associates

Total Project Cost: (all years) Undetermined

Total Project Cost: (1983 only) Nil

Start Date: December 1983

Completion Date: 1985

Project Manager: Donald M. Paterson, (416) 261-7128

Dissemination of Results: To be determined

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Project Objective, Scope, Background, and Methodology:

The purpose of the GO-ALRT program is to select an alignment for protection of an inter-regional rapid transit right-of-way which best satisfies social, economic, land use, environmental, and transportation objectives. The objectives of the land/use social environmental consultants working on the project are to identify the alignment which offers the greatest potential to support municipal and provincial land use/social environmental goals while minimizing adverse impacts on the community. The GO-ALRT program thus offers the opportunity to not only improve transit efficiency, but also to attain other land use and social environmental goals.

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Project Results/Conclusions/Preliminary Findings:

Not yet available.

- -

Further Research Work Identified:

To be determined.

Project Number:	183
Subject:	Rapid Transit Studies
Submitted by:	Toronto Transit Commission

- -

Project Title: Harbourfront L.R.T.

Title of Report: Centreal Waterfront Area Transit Plan - Proposed Harbourfront L.R.T. (Draft)

Funding Source(s) and % Share: Ontario Ministry of Transportation and Communications, (75%)/Metropolitan Toronto, (25%)

Consultants/Contractors Used: None

Total Project Cost: (all years)	-	Total Project Cost: (1983 only)	-
Start Date:	1983	Completion Date:	1984

Project Manager: S.T. Lawrence, Toronto Transit Commission, (416) 481-4252

Dissemination of Results: Public report

- -

Project Objective, Scope, Background, and Methodology:

A study of the central waterfront area identified a requirement for a Harbourfront L.R.T. The purpose of this project is to determine the exact alignment of a high speed L.R.T. serving the waterfront. The line is expected to carry 4,500 - 6,500 passengers per hour per direction and will require fully integrated transfer facilities and ful right-of-way protection.

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Project Results/Conclusions/Preliminary Findings:

Preliminary report completed including preliminary reference drawings, cost estimates, system alignments, and operating characteristics.

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Further Research Work Identified:

N/A

Project Number: 184
Subject: Rapid Transit Studies
Submitted by: Toronto Transit Commission

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Project Title:	Sheppard Avenue R.T. Study		
Title of Report:	North Metro Rapid Transit		
Funding Source(s) and % Share:	Toronto Transit Commission (100%)		
Consultants/Contractors Used:	None		
Total Project Cost: (all years)	$100,000	Total Project Cost: (1983 only)	-
Start Date:	1984	Completion Date:	1984
Project Manager:	J.A. Miller, Toronto Transit Commission, (416) 481-4252		
Dissemination of Results:	Internal staff report		

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Project Objective, Scope, Background, and Methodology:

In response to TTC reports and proposals for an east/west GO ALRT line north of Highway 401, a feasibility study is currently underway to determine the alignment and technology of a Sheppard Avenue rapid transit line connecting the Spadina Subway, the North York City Centre, and the Scarborough Town Centre. The study will be conducted within the framework of the GO ALRT study noted above and include recommendations on technology, alignment, and phasing for a Sheppard Avenue line.

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Project Results/Conclusions/Preliminary Findings:

Work is currently underway.

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Further Research Work Identified:

N/A

Project Number: 185
Subject: Rapid Transit Studies
Submitted by: Toronto Transit Commission

- -

Project Title: Rail Yard Need Study: To 2001

Title of Report: Rail Yard Need Study: To 2001

Funding Source(s) and % Share: Toronto Transit Commission (100%)

Consultants/Contractors Used: None

Total Project Cost: (all years) $40,000 Total Project Cost: (1983 only) $35,000

Start Date: 1983 Completion Date: 1984

Project Manager: J. Davies, Toronto Transit Commission, (416) 481-4252

Dissemination of Results: Report to TTC Management

- -

Project Objective, Scope, Background, and Methodology:

The purpose of the project is to identify longer-term rail vehicle storage and maintenance requirements for future rapid transit network expansion including an evaluation of potential rail yard sites across Metro. A total of 13 potential sites were identified and evaluated based on three network expansion scenarios to the year 2001. Detailed descriptions of these sites including maps and aerial photographs are included. Preferred sites were identified using four evaluation criteria: capital costs, operating costs, site considerations, and operating concerns.

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Project Results/Conclusions/Preliminary Findings:

Report completed: January 1984. Conclusions restricted to internal use only.

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Further Research Work Identified:

Project Number:	186
Subject:	Impact of Transit
Submitted by:	City of Calgary/Calgary Transit

- -

Project Title:	South LRT Impact Study		
Title of Report:	South LRT Impact Study		
Funding Source(s) and % Share:	Province of Alberta, (66 2/3%)/City of Calgary, (33 1/3%)		
Consultants/Contractors Used:	None		
Total Project Cost: (all years)	$234,000	Total Project Cost: (1983 only)	$56,000
Start Date:	January 1981	Completion Date:	January 1984
Project Manager:	D. Bolger, City of Calgary, Transportation Department, (403) 268-1631		
Dissemination of Results:	Report available from Transportation Department, City of Calgary, P.O. Box 2100, Calgary, Alberta, T2P 2M5.		

- -

Project Objective, Scope, Background, and Methodology:

In May 1981, the City of Calgary commenced revenue service on the first leg of Calgary's light rail transit system. The objective of this study is to measure and document the effect light rail transit has had upon travel behaviour (generation, distribution, mode choice, attitudes) and finances. The study utilized ground counts, on-board surveys and home interview surveys to obtain measurements on the magnitude and type of changes in travel behaviour.

- -

Project Results/Conclusions/Preliminary Findings:

Calgary's first line of light rail transit and feeder bus system caused a significant shift from auto to transit in both the peak and off peak periods for travel destined to the central business district. For non-downtown travel the LRT system has had little impact. Although the LRT system has generated a shift in mode choice there has been virtually no effect on trip generation or distribution.

- -

Further Research Work Identified:

Project Number: 187
Subject: Impact of Transit
Submitted by: City of Edmonton/Edmonton Transit/University of Alberta, Department of Civil Engineering

- -

Project Title: LRT Impact Analysis

Title of Report: Not known

Funding Source(s) and % Share: City of Edmonton, (33%)/Alberta Transportation, (66%)

Consultants/Contractors Used: University of Alberta, Civil Engineering Department, Professor J.J. Bakker

Total Project Cost: (all years) $25,000 Total Project Cost: (1983 only) $10,000

Start Date: April 1983 Completion Date: December 1984

Project Manager: -

Dissemination of Results: None available

- -

Project Objective, Scope, Background, and Methodology:

The 1979 Northeast Light Rail Transit Evaluation Study was primarily concerned with gathering information to evaluate the operational effectiveness and impacts of LRT in Edmonton. This project will assess the impact of LRT on the travel characteristics of residents within the area of influence of LRT line. Data will be drawn from the 1961, 1971, 1976, and 1981 Civic Census. Destinations assessed will include the Central Business District, Central Area, and the University of Alberta. Origins will be in NE Edmonton for those impacted by LRT. A control area away from LRT influence has been determined to permit a reliable assessement of the impact of LRT.

- -

Project Results/Conclusions/Preliminary Findings:

Project continuing. No results to date.

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Further Research Work Identified:

Project Number: 188
Subject: Impact of Transit
Submitted by: Damas & Smith Ltd.

Project Title: Travel Behaviour at Transit Stations

Title of Report: Travel Behaviour Associated with Land Uses Adjacent to Rapid Transit Stations

Funding Source(s) and % Share: Damas & Smith, (100%)

Consultants/Contractors Used: Damas & Smith, A Division of DSL Consultants Ltd.

Total Project Cost: (all years) $1,000 Total Project Cost: (1983 only) $530

Start Date: 1980 Completion Date: Ongoing

Project Manager: M. Stringham, (416) 491-0111

Dissemination of Results: ITE paper, RTAC paper, internal report

Project Objective, Scope, Background, and Methodology:

Identify the "impact zone" of rapid transit stations. Identify trip generation by mode for alternative land uses. Identify mode of access to the rapid transit station relative to distance. Over 2000 surveys were completed at stations in Toronto and Edmonton at residences and at employment locations.

Project Results/Conclusions/Preliminary Findings:

Impact zone (walk-in access mode) is up to 1200 m, as opposed to the conventional transit walk-in distance of 400 m. Proximity to a rapid transit station significantly influences the selection of home and/or job locations. Results have been used for transportation impact analysis of proposed developments near LRT stations in Calgary and Edmonton.

Further Research Work Identified:

Updating as required. Verify applications to developments near Calgary and Edmonton LRT stations.

Project Number: 189
Subject: Impact of Transit
Submitted by: University of Calgary, Department of Civil Engineering

Project Title: Evaluation of Urban Transportation Systems Using a Behavioural Approach

Title of Report: Evaluation and Choice of Urban Transportation System

Funding Source(s) and % Share: National Science and Engineering Research Council of Canada, (100%)

Consultants/Contractors Used: M.A. Sargious, (Professor) and C.K. Bee (Research Associate)

Total Project Cost: (all years) $46,281 Total Project Cost: (1983 only) $1,600

Start Date: April 1979 Completion Date: March 1983

Project Manager: M.A. Sargious, Professor, Department of Civil Engineering, University of Calgary

Dissemination of Results: Research report distributed to the transportation departments of the large Canadian cities, technical papers published in various scientific journals

Project Objective, Scope, Background, and Methodology:

The major objective of the project was to develop a comprehensive procedure for evaluating the impacts of urban transportation system developments or improvements on the various groups affected by the system. The procedure was intended for cities with population ranging between half and one million people. The method used represents a shift from the traditional approach of considering economic and engineering design criteria to one in which a policy oriented approach is used to incorporate the complex interrelationships between the system users, operator, and the community at large. A discrete choice (logit) model was used, together with the concept of consumer surplus, for the evaluation from the point of view of the users and operator. The evaluation and quantification of the impacts of system changes or improvement on the community was undertaken by using a carefully designed questionnaire in face-to-face interviews with five subgroups of the community. Utility curves of community reactions were developed using utility theory and the fractile method. Compensated demand curves were then derived from these and used to obtain the monetary benefits of the various system changes.

Project Results/Conclusions/Preliminary Findings:

The procedure was applied to a light rail transit line which has been constructed recently in the S.W. corridor of the City of Calgary, Alberta with population of about 600,000 people. The results indicated major benefits to the users of the system and disbenefits to the community. When both benefits and disbenefits were considered together and compared with the additional cost of the system over another alternative, the construction of the light rail transit line was found to be advantageous.

Further Research Work Identified:

None

Project Number: 190
Subject: Impact of Transit
Submitted by: Ontario Ministry of Transportation and Communications

Project Title: Micro Economic Impact Evaluation Model

Title of Report: Micro Economic Impact Evaluation Model-Transit Applications

Funding Source(s) and % Share: Ontario Ministry of Transportation and Communications, (100%)

Consultants/Contractors Used: R.S. Consulting

Total Project Cost: (all years) $20,000
Total Project Cost: (1983 only) $5,000

Start Date: July 1983
Completion Date: July 1984

Project Manager: James Stirling, Policy Planning Branch, MTC

Dissemination of Results: GO-ALRT, MTC

Project Objective, Scope, Background, and Methodology:

The M.I.E.S. is a computer-based, input-output economic model which evaluates the impact of spending on the national economy. It has been successfully applied at M.T.C. in the area of Provincial roads spending and the Ministry wishes to extend its application to transit related projects. The application is limited to current technology and construction methods and materials. The model will be recalibrated to reflect the sources of spending in a typical transit project (eg. steel, plastics, electrical controls, etc.) and be tested using the GO-ALRT east project.

Project Results/Conclusions/Preliminary Findings:

The product is a model that will enable the assessment of economic impacts of spending on transit related projects. The work is in progress, consequently no findings are presently available.

Further Research Work Identified:

None at this time.

Project Number:	191
Subject:	Impact of Transit
Submitted by:	Ontario Urban Transit Association

Project Title:	Environmental Assessment		
Title of Report:	Municipal Transit Class Environmental Assessment		
Funding Source(s) and % Share:	Ontario Ministry of Transportation and Communications, (100%)		
Consultants/Contractors Used:	Ecoplans Ltd.		
Total Project Cost: (all years)	-	Total Project Cost: (1983 only)	-
Start Date:	1981	Completion Date:	December 1983
Project Manager:	C.H. Prentice, Brampton Transit, (416) 453-3468		
Dissemination of Results:	Available from OUTA		

Project Objective, Scope, Background, and Methodology:

The major undertakings of municipalities (including transit) became subject to the Environmental Assessment Act effective June 30, 1980. An exception was granted to allow the development of class environmental assessment document to replace the existing TATOA document. A working group was established including representives from OUTA, MTC, and the Ontario Ministry of the Environment to develop a new Class E.A.

Project Results/Conclusions/Preliminary Findings:

Class E.A. submitted to the Ministry of the Environment for approval. OUTA requested to act as an agent on behalf of Ontario properties in obtaining necessary approval from MOE. Draft resolution for the approval of municipal councils forwarded to selected Ontario municipalities by OUTA. Approved resolutions forwarded to MOE. Approval process for Class E.A. currently underway by MOE staff.

Further Research Work Identified:

Project Number:	192		
Subject:	Terminals/Bus Shelters/Bus Bays/Park and Ride		
Submitted by:	Quebec Ministry of Transport		

Project Title:	Intermodal Terminal		
Title of Report:	Intermodal Terminal in Downtown Montreal - Preliminary Considerations to the Feasibility Study for a "Road Terminal"		
Funding Source(s) and % Share:	Quebec Ministry of Transport, (100%)		
Consultants/Contractors Used:	Canatrans Consulting/Transurb Inc.		
Total Project Cost: (1983 - 1984)	$35,000	Total Project Cost: (1983 only)	$20,000
Start Date:	1981	Completion Date:	April 1984
Project Manager:	Nguyen Quang Quy, (418) 643-1675		
Dissemination of Results:	-		

Project Objective, Scope, Background, and Methodology:

Ministry of transport is interested in integrating all modes - commuter trains, subway, buses for Montreal South Shore and for Mirabel. To evaluate the potential for a multimodal terminal, a study of world-wide experiences has been conducted. The adaptation of this concept to Montreal's situation has been analyzed.

Project Results/Conclusions/Preliminary Findings:

Elsewhere every terminal is conceived differently. Further study will be required to see if one of these solutions is applicable to Montreal or a new design should be developed.

Further Research Work Identified:

Pending the decision of municipal and provincial authorities, design studies will be undertaken.

Numéro du Projet 192
Sujet: Terminals/Bus Shelters/Bus Bays/Park and Ride
Soumis par: Ministère des Transports du Québec

Titre du projet:	Carrefour des transports		
Titre du rapport:	Carrefour des transports au centre-ville de Montréal-considérations préalables à l'étude de faisabilité d'une gare routière		
Source de financement et Pourcentage des coûts défrayés par chaque organisme:	Ministère des Transports du Québec		
Consultants/Sous-traitants:	Canatrans/Transurb		
Coût total: (toutes les années)	$35,000	Coût total du projet: (1983 seulement)	$20,000
Le projet débute le:	1981	Fin du projet:	Avril 1984
Directeur du projet:	Nguyen Quang Quy, (418) 643-1765		
Dissémination des résultats:	-		

But, étendue, antécédents et méthodologie du projet:

Le Ministère des Transports s'intéresse à l'intégration de tous les modes de transports - trains de banlieue, métro, autobus CTRSM, autobus pour Mirabel dans le centre-ville de Montréal. Pour évaluer le potentiel d'un carrefour, une étude des expériences à travers le monde a été entreprise. L'adaptation de ce concept à la situation particulière de Montréal a été analysée.

Résultats/Conclusions/Résultats préliminaires:

Ailleurs, chaque carrefour est de conception différente. Il faudra vérifier si une de ces solutions est applicable à Montréal ou si on doit innover.

Travail de recherche additionnel identifié:

Dépendant de la réponse des dirigeants municipaux et provinciaux, il faudra entreprendre les études de design.

Project Number:	193
Subject:	Terminals/Bus Shelters/Bus Bays/Park and Ride
Submitted by:	Beauchemin-Beaton-Lapointe, Inc./Transurb

- -

Project Title:	Local Potential for Multi-Modal Transit Terminals		
Title of Report:	Local Potential for Multi-Modal Transit Terminals		
Funding Source(s) and % Share:	Centre de développement des transports, (100%)		
Consultants/Contractors Used:	Beauchemin-Beaton-Lapointe, Inc.		
Total Project Cost: (all years)	$29,000	Total Project Cost: (1983 only)	$29,000
Start Date:	May 1983	Completion Date:	November 1983
Project Manager:	Liliane Demers, (514) 871-9555		
Dissemination of Results:	CDT Study		

- -

Project Objective, Scope, Background, and Methodology:

To identify, among towns of population 15 to 300,000, those which have a potential to house a multimodal station. A questionnaire was sent to municipal authorities of all such cities, which were served by more than one mode: intercity and city buses being two modes. Transport companies were also contacted. From a preset list of criteria the cities with the best potential for a multi-modal station were chosen.

- -

Project Results/Conclusions/Preliminary Findings:

A number of cities have a strong potential for a multimodal stations, 95 cities have an average potential for a multimodal stations, 68 have no potential.

- -

Further Research Work Identified:

No

Project Number: 194
Subject: Terminals/Bus Shelters/Bus Bays/Park and Ride
Submitted by: Saskatoon Transit

- -

Project Title: Downtown Transit Terminal

Title of Report: Downtown Transit Terminal Functional Planning Study

Funding Source(s) and % Share: Saskatchewan Urban Affairs, (75%)

Consultants/Contractors Used: None

Total Project Cost: (all years) -
Total Project Cost: (1983 only) -

Start Date: December 1982
Completion Date: March 1983

Project Manager: J.A. Ross, Saskatoon Transit, (306) 664-9113

Dissemination of Results: -

- -

Project Objective, Scope, Background, and Methodology:

The 1977 Saskatoon Transportation Study recommended that an on-street parking mall on 21st Street be converted to a exclusive downtown transit terminal to accommodate bus transfers at a central location. Subsequent studies concluded that the 23rd Street site was the preferable location for the downtown transit terminal because 23rd Street is as central to the existing and future downtown as 21st Street, it is more convenient and economical to service by transit, and it is already being used as a downtown transfer point. In 1982, a study was undertaken to develop a functional plan for a downtown bus terminal on 23rd Street. The methodology included a computer simulation model of traffic flows in the CBD, a simulation of the impact of a partial closure of 23rd Street to accommodate a terminal, the development of terminal design criteria and evaluation of terminal options.

- -

Project Results/Conclusions/Preliminary Findings:

Existing traffic control system does not have sufficient residual capacity to handle the re-distribution of traffic resulting from the closure of one block for the terminal. Model network can handle redistributed traffi with a net benefit to traffic flows. An exclusive transit terminal should be constructed using a modified sawtooth design concept.

- -

Further Research Work Identified:

Detailed design study currently underway.

Project Number: 195
Subject: Terminals/Bus Shelters/Bus Bays/Park and Ride
Submitted by: Kitchener Transit

Project Title: Kitchener Transit Mall Feasibility Study

Title of Report: Not yet determined

Funding Source(s) and % Share: Not yet determined

Consultants/Contractors Used: Not yet determined

Total Project Cost: (all years) $75,000 — Total Project Cost: (1983 only) None

Start Date: 1984 — Completion Date: 1984

Project Manager: J.A.B. Webster, Kitchener Transit, (519) 885-7286

Dissemination of Results: Not yet determined

Project Objective, Scope, Background, and Methodology:

The objective of the study is to determine the feasibility of developing a transit mall, restricted primarily to public transit vehicles in downtown Kitchener. The study will identify and examine the following: impact on existing and future transit ridership, passenger accessibility, bus and automobile movements and interactions, geometric design requirements, costs and benefits, effect on transit schedules, environmental impact, possible shelter types and structures, automated public information systems, impact on transit transfer policies, pedestrian safety and control, impact on surrounding buildings, drainage requirements, maintenance options, fire regulations, legal agreements, street aesthetics, housing in the downtown, urban renewal and revitalization in the downtown core, the impact on the tax base, and other related factors.

Project Results/Conclusions/Preliminary Findings:

Not yet available. Study approved by City Council and currently underway.

Further Research Work Identified:

Project Number: 196
Subject: Terminals/Bus Shelters/Bus Bays/Park and Ride
Submitted by: City of Calgary/Calgary Transit

- -

Project Title: Park "N" Rider Report

Title of Report: Calgary Transit - Park "N" Ride Facilities

Funding Source(s) and % Share: City of Calgary, (100%)

Consultants/Contractors Used: None

Total Project Cost: (all years) $1,000 Total Project Cost: (1983 only) $1,000

Start Date: March 1983 Completion Date: March 1984

Project Manager: D. Bolger, City of Calgary, Transportation Department, (403) 268-1631

Dissemination of Results: Internal use only

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Project Objective, Scope, Background, and Methodology:

The report updates a basic inventory of park "n" ride facilities in Calgary, records present level of use, and identifies future locations and requirements for park "n" ride facilities.

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Project Results/Conclusions/Preliminary Findings:

The report documents that the level of use of park "n" ride sites is highest in South LRT corridor. Additionally, certain areas of the City are identified as being deficient in park "n" ride development.

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Further Research Work Identified:

N/A

Project Number:	197
Subject:	Terminals/Bus Shelters/Bus Bays/Park and Ride
Submitted by:	Quebec Ministry of Transport

- -

Project Title:	Park and Ride		
Title of Report:	(1) Exchange Parking: Concept and Realisation (2) Exchange Parking in Brossard		
Funding Source(s) and % Share:	Quebec Ministry of Transport		
Consultants/Contractors Used:	None		
Total Project Cost: (1983 - 1984)	$50,000	Total Project Cost: (1983 only)	$4,000
Start Date:	1979	Completion Date:	-
Project Manager:	Nguyen Quang Quy/Yvon Parenteau, (418) 643-1675		
Dissemination of Results:	-		

- -

Project Objective, Scope, Background, and Methodology:

Ojbectives are the modelling of the park and ride phenomenon and the development of an incentive policy. Within the framework of this study, inventory of available parking lots in the Montreal Region has been conducted for use as park and ride facilities.

- -

Project Results/Conclusions/Preliminary Findings:

The Brossard park and ride facility was somewhat a failure for several reasons. The study has shown that such parkings are necessary for solving transportation problems. The experiment has encouraged the CTRSM to establish another parking in St-Hubert. Administrative and legal problems have arisen since customers are mostly from the outside of the CTRSM's territory. There have also been problems in publicity and system changes.

- -

Further Research Work Identified:

Identify corrective measures to improve parking usage.

Numéro du Projet	197
Sujet:	Terminals/Bus Shelters/Bus Bays/Park and Ride
Soumis par:	Ministère des Transports du Québec

Titre du projet:	Parkings d'échange		
Titre du rapport:	Parkings d'échange: concept et réalisation, Parking d'échange à Brossard		
Source de financement et Pourcentage des coûts défrayés par chaque organisme:	Ministère des Transports du Québec, (100%)		
Consultants/Sous-traitants:	-		
Coût total: (1983-1984)	$50,000	Coût total du projet: (1983 seulement)	$4,000
Le projet débute le:	1979	Fin du projet:	-
Directeur du projet:	Nguyen Quang Quy/Yvon Parenteau, (418) 643-1675		
Dissémination des résultats:	-		

But, étendue, antécédents et méthodologie du projet:

Les buts sont: la modélisation du phénomène et l'élaboration d'une politique d'encouragement. Dans le cadre de cette recherche, on a préparé un inventaire des terrains disponibles dans la région de Montréal.

Résultats/Conclusions/Résultats préliminaires:

Le stationnement de Brossard a connu un peu l'échec pour de multiples raisons. Le projet de recherche a permis d'établir que la création de tels stationnements est essentielle à la solution de problèmes de transport. L'expérience a incité la CTRSM d'établir elle-même un autre stationnement à St-Hubert. Des problèmes administratifs et juridiques ont surgi puisque la clientèle provient surtout de l'extérieur du territoire de la CTRSM. Il y a également eu des problèmes de publicité et d'ajustement au réseau.

Travail de recherche additionnel identifié:

L'identification de mesures correctrices pour améliorer l'utilisation des stationnements.

Project Number: 198
Subject: Terminals/Bus Shelters/Bus Bays/Park and Ride
Submitted by: Canadian Urban Transit Association

Project Title: Bus Shelters - Questionnaire 83-2

Title of Report: The Planning, Installation, and Maintenance of Bus Shelters: An Overview of the Canadian Experience

Funding Source(s) and % Share: Canadian Urban Transit Association, (100%)

Consultants/Contractors Used: None

Total Project Cost: (all years) -
Total Project Cost: (1983 only) -

Start Date: March 1983
Completion Date: May 1983

Project Manager: C. Wheeler, Canadian Urban Transit Association, (416) 365-9800

Dissemination of Results: Results available from CUTA

Project Objective, Scope, Background, and Methodology:

The purpose of the questionnaire was to determine the policies and practices currently in effect in Canadian municipalities with respect to the planning, installation, and maintenance of bus shelters. A questionnaire was distributed to all CUTA operating members.

Project Results/Conclusions/Preliminary Findings:

A total of 41 transit operators responded to the questionnaire. The placement, ownership, and maintenance of bus shelters varies considerably among transit operators. Site selection criteria range from sophisticated point systems to simple evaluations based on passenger boardings. Although the type of land use often determines the priority for shelter location, a number of other factors are considered. There is considerable variance in the factors used by municipalities of various sizes.

Further Research Work Identified:

Project Number: 199
Subject: Terminals/Bus Shelters/Bus Bays/Park and Ride
Submitted by: City of Calgary/Calgary Transit

Project Title: Bus Stops Standards

Title of Report: Bus Zone Report

Funding Source(s) and % Share: City of Calgary, (100%)

Consultants/Contractors Used: None

Total Project Cost: (all years) $5,000 Total Project Cost: (1983 only) -

Start Date: 1979 Completion Date: March 1984

Project Manager: D. Bolger, City of Calgary, Transportation Department, (403) 268-1631

Dissemination of Results: Report - internal circulation

Project Objective, Scope, Background, and Methodology:

The Bus Zone Report investigates bus zone design, location, signing, and spacing.

Project Results/Conclusions/Preliminary Findings:

A recommended set of guidelines for bus zone placement in Calgary are provided by the Bus Zone Report.

Further Research Work Identified:

N/A

Project Number: 200
Subject: Terminals/Bus Shelters/Bus Bays/Park and Ride
Submitted by: City of Calgary/Calgary Transit

Project Title: Bus Bay Construction

Title of Report: None

Funding Source(s) and % Share: City of Calgary, Transportation Department (100%)

Consultants/Contractors Used: City of Calgary

Total Project Cost: (all years) $71,000 Total Project Cost: (1983 only) -

Start Date: Pending Completion Date: -

Project Manager: W.R. Samples, Field Engineer, Engineering Department, Streets Division, City of Calgary

Dissemination of Results: N/A

Project Objective, Scope, Background, and Methodology:

To design and construct four bus bays at the following locations: 1) Simon Valley Drive at 78 Avenue N.W. Northbound; 2) Crowfoot Shopping Centre on Nosehill Drive N.W. 3) Anderson Road S.W. at Elbow Drive (Eastbound) 4) Anderson Road S.W. at Elbow Drive (Westbound). Benefits: 1) To improve traffic safety by decreasing potential rear-end collisons and other accidents caused by lane-change manoeuvers; 2) To eliminate vehicular delays caused by buses stopped in through lanes; 3) To provide a safer and more pleasant environment for bus patrons boarding and alighting by setting them back from the through lane activity.

Project Results/Conclusions/Preliminary Findings:

Not yet available.

Further Research Work Identified:

Project Number: 201
Subject: Operational Planning Studies - Regular Transit
Submitted by: City of Edmonton/Edmonton Transit

Project Title: Bus Deadhead Study

Title of Report: An Evaluation of Deadhead Operations in Transit

Funding Source(s) and % Share: City of Edmonton, (100%)

Consultants/Contractors Used: None

Total Project Cost: (all years) N/A
Total Project Cost: (1983 only) N/A

Start Date: November 1983
Completion Date: January 1984

Project Manager: Lal Wahi, Edmonton Transit, (403) 428-5525

Dissemination of Results: Internally circulated, available from Edmonton Transit

Project Objective, Scope, Background, and Methodology:

This study was conducted to investigate vehicle deadhead operations, a non-productive component of service hours to increase effective utilization of the total allocated service hours. Recent cuts in transit service focussed on the reduction of service hours to the public and did not consider deadhead operations. Initial observations suggested that the start and finish points of service runs were not necessarily at the most effective locations considering prime direction of travel. Methodology included assessment of start and finish locations of all service runs and on-board deadhead time tests for accurate deadhead times.

Project Results/Conclusions/Preliminary Findings:

Total savings due to both the service start and finish location modifications and due to revision of deadhead time and routing schedule, it adopted, were estimated to be 600 hours/week.

Further Research Work Identified:

Project Number:	202
Subject:	Operational Planning Studies - Regular Transit
Submitted by:	City of Edmonton/Edmonton Transit

- -

Project Title:	Storage Optimization Study		
Title of Report:	Bus Storage Optimization Study		
Funding Source(s) and % Share:	City of Edmonton, (100%)		
Consultants/Contractors Used:	None		
Total Project Cost: (all years)	N/A	Total Project Cost: (1983 only)	N/A
Start Date:	July 1982	Completion Date:	N/A
Project Manager:	Lal Wahi, Edmonton Transit, (403) 428-5525		
Dissemination of Results:	Available at Edmonton Transit		

- -

Project Objective, Scope, Background, and Methodology:

The main purpose of the study was to provide an optimal fleet storage plan to minimize costs of deadhead travel and of infra-structure improvement requirements with reference to future vehicle acquisitions of articulated buses and standard trolleys. It was not clear if it would be advisable and cost effective to store articulated buses (in future) all in one garage or in more than one. Infra-structure upgrading to distribute trolleys among all garages required significant ($5 million) investment.

- -

Project Results/Conclusions/Preliminary Findings:

It was concluded that infra-structure upgrading was not justified to store trolleys in all 5 garages (3 garages were already handling trolleys). It was also recommended that all 5 garages be retrofitted for the 1993 storage of articulated buses.

- -

Further Research Work Identified:

Project Number: 203
Subject: Operational Planning Studies - Regular Transit
Submitted by: City of Calgary/Calgary Transit

Project Title: Calgary Transit Pilot Project - Early Implementation of Full Service

Title of Report: Pilot Project on Early Implementation of Full Transit Service - Route 54 Edgemont

Funding Source(s) and % Share: City of Calgary, (100%)

Consultants/Contractors Used: None

Total Project Cost: (all years) -   Total Project Cost: (1983 only) -

Start Date: August 1981   Completion Date: April 1983

Project Manager: D. Bolger, City of Calgary, Transportation Department, (403) 268-1631

Dissemination of Results: Reports available from the City of Calgary Transportation Department, P.O. Box 2100, Calgary, Alberta, T2P 2M5

Project Objective, Scope, Background, and Methodology:

Purpose was to determine if the introduction of full transit service rather than peak hour service into a developing residential area at the initial stage could create an earlier and higher use of transit than is normally developed by the staging method. Full transit service was introduced into a developing residential area having no existing service. The magnitude and rate of ridership and population growth was monitored at various time intervals and compared to two other areas where full service has been reached by progressively increasing service through the staging method.

Project Results/Conclusions/Preliminary Findings:

Within the limited time frame of the experiment, there was no evidence to indicate that the early implementation of full service into a developing residential area resulted in the ridership generation rate being significantly different from other areas where a procedure of staged implementation of service was followed.

Further Research Work Identified:

Nil

Project Number:	204
Subject:	Operational Planning Studies - Regular Transit
Submitted by:	City of Calgary/Calgary Transit

Project Title: Calgary General Hospital and Foothills Hospital Comparative Transportation Study

Title of Report: Calgary General Hospital and Foothills Hospital Comparative Transportation Study

Funding Source(s) and % Share: City of Calgary/Foothills Hospital, (100%)

Consultants/Contractors Used: -

Total Project Cost: (all years) $5,000 Total Project Cost: (1983 only) $3,000

Start Date: January 1, 193 Completion Date: February 1984

Project Manager: D. Bolger, City of Calgary, Transportation Department, (403) 268-1631

Dissemination of Results: Internal report

Project Objective, Scope, Background, and Methodology:

Objective was to compare results of two transportation studies: 1) Calgary General Hospital transportation study - City of Calgary Transportation Department; 2) Foothills Hospital Parking Study - Marshall Macklin Monaghan. Scope included an examination of Modal Split of Staff, Patients, Visitors, Travel Characteristics, Parking Demand, Attitude towards transit. Request for better transit service by Calgary General Hospital. Parking problems experienced by Foothills Hospital. Methodology included a Questionnaire and traffic counts.

Project Results/Conclusions/Preliminary Findings:

Mode split to hospitals - staff: Foothills Hospital: Transit 21%, Auto 62%, Walk 16%, Other 1%. Calgary General Hospital: Transit 31%, Auto 63%, Walk 6%, Other 0%

Further Research Work Identified:

Establish marketing program to provide information to hospital staff Re: transit service and schedules.

Project Number:	205
Subject:	Operational Planning Studies - Regular Transit
Submitted by:	City of Calgary/Calgary Transit

Project Title:	Mount Royal College/University of Calgary Transit Study		
Title of Report:	Mount Royal College Transit Study / University of Calgary Transit Study		
Funding Source(s) and % Share:	City of Calgary, (100%)		
Consultants/Contractors Used:	None		
Total Project Cost: (all years)	$6,000	Total Project Cost: (1983 only)	-
Start Date:	1982	Completion Date:	June 1984
Project Manager:	D. Bolger, City of Calgary, Transportation Department, (403) 268-1631		
Dissemination of Results:	Transportation Department, Mount Royal College and University of Calgary		

Project Objective, Scope, Background, and Methodology:

To establish the transit requirements for post secondary educational institutions and to evaluate the effectiveness of existing service in meeting these requirements.

Project Results/Conclusions/Preliminary Findings:

This project will identify travel patterns of personnel connected to post secondary educational institutions. Thes travel patterns will become input in design modifications to the overall transportation network.

Further Research Work Identified:

Project Number:	206
Subject:	Operational Planning Studies - Regular Transit
Submitted by:	City of Calgary/Calgary Transit

Project Title:	7 Avenue South Transit Corridor Study		
Title of Report:	7 Avenue South Transit Corridor Study		
Funding Source(s) and % Share:	City of Calgary, (100%)		
Consultants/Contractors Used:	Assistance obtained from Civil Engineering Department, University of Calgary		
Total Project Cost: (all years)	$20,000	Total Project Cost: (1983 only)	$20,000
Start Date:	January 1983	Completion Date:	March 1984
Project Manager:	D. Bolger, City of Calgary, Transportation Department, (403) 268-1631		
Dissemination of Results:	Reports available from the City of Calgary, Transportation Department, P.O. Box 2100, Calgary, Alberta, T2P 2M5		

Project Objective, Scope, Background, and Methodology:

The South LRT line currently operates in the downtown on an exclusive transit corridor (bus and LRT vehicles). The Northeast line, currently under construction, will also operate along this corridor once it begins revenue service in the summer of 1985. The objectives of this study were to examine the existing operations, to identify operating criteria for LRT, buses, cross-street traffic and pedestrians, to identify and evaluate various terminal alternatives in the downtown and to develop an operating strategy for the corridor. With respect to these objectives, the impact of operating two LRT lines on 7 Avenue South was examined relative to: the capacity of 7 Avenue South for LRT vehicles, the number of buses which can be accommodated in conjunction with LRT, and, the effect of LRT operations on the vehicle carrying capacity of the cross-streets. Much of the work relative to this project was completed in conjunction with the Civil Engineering Department at the University of Calgary where a simulation program was developed to optimize corridor operations.

Project Results/Conclusions/Preliminary Findings:

A general operating strategy for LRT in this corridor has been established. In addition, the configuration for the west terminal has been finalized. Optimization of operations in the corridor has identified the need for revisions to bus routes in the downtown.

Further Research Work Identified:

Project Number: 207
Subject: Operational Planning Studies - Regular Transit
Submitted by: Joint Program in Transportation

Project Title: The Effects of Schedule Policy on Waiting Times of Transfering Passengers

Title of Report: The Effects of Schedule Policy on Waiting Times of Transfering Passengers

Funding Source(s) and % Share: Transport Canada Student Research Grant, (100%)

Consultants/Contractors Used: J. Devney (Researcher)

Total Project Cost: (all years) $3,500

Total Project Cost: (1983 only) -

Start Date: 1982

Completion Date: 1983

Project Manager: G.N. Steuart, Joint Program in Transportation, (416) 978-7282

Dissemination of Results: Joint Program Research Report

Project Objective, Scope, Background, and Methodology:

The major objective of this research was to determine how the waiting times of tranferring transit passengers are affected by different service frequencies and scheduling policies. Scheduling methods, such as the timed-transfer concept and non-coordinated transit services, will be compared to determine when they are appropriate for use. The timed-transfer or coordinated schedule which reduces the transfer times has been implemented in some Canadian cities, such as Edmonton and London. These cities, which have a large low-density urban development, required a transit system which provided a convenient, multi-destinational service with minimal transfer times. Other Canadian transit authorities are debating the usefulness of coordinated schedules. Research comparing the timed-transfer system to conventional scheduling is required. In this research, the waiting times of passengers transferring between transit services at off-street stations will be studied. The waiting time at the bus stop is only one component of a passenger's transfer time which also consists of the walk time from the last bus or train and the time spent in other parts of the station. This waiting time is determined by the passenger's arrival time and the departure time of the bus.

Project Results/Conclusions/Preliminary Findings:

Not yet available.

Further Research Work Identified:

Project Number: 208
Subject: Operational Planning Studies - Disabled Transit
Submitted by: Alberta Transportation

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Project Title: Transportation Needs of the Transportation Handicapped in Alberta Cities

Title of Report: Transportation Needs of the Transportation Handicapped in Alberta Cities

Funding Source(s) and % Share: Alberta Transportation, (100%)

Consultants/Contractors Used: GCG Engineering Partnership

Total Project Cost: (all years) $36,000 — Total Project Cost: (1983 only) $36,000

Start Date: January 1983 — Completion Date: May 1983

Project Manager: -

Dissemination of Results: Final report prepared for Provincial Government use and distribution to Cities

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Project Objective, Scope, Background, and Methodology:

Project objective was to establish current and future demand levels for the transportation services for the disabled; determine the level to which the existing transportation service accommodate existing service demand: determine existing system and service characteristics; determine characteristics of user; estimate cost of and revenues of each system over the next five years; identify the funding policies of the Alberta Government as well as those used in other provinces. A comprehensive data collection program was undertaken in every city and Sherwood Park. The results were documented and all data was included in an appendix.

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Project Results/Conclusions/Preliminary Findings:

Implications of ridership trends and various scenarios to funding were looked at as well as future system requirements. The report provided a good state-of-the-art review of disabled transportation services in Alberta cities.

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Further Research Work Identified:

N/A

Project Number:	209
Subject:	Operational Planning Studies - Disabled Transit
Submitted by:	City of Calgary/Calgary Transit

Project Title:	Transportation Needs of the Elderly and Handicapped in Calgary		
Title of Report:	Transportation Needs of the Elderly and Handicapped in Calgary		
Funding Source(s) and % Share:	Alberta Transportation, (66 2/3%)/City of Calgary, (33 1/3%)		
Consultants/Contractors Used:	City of Calgary Transportation Department		
Total Project Cost: (all years)	$50,000	Total Project Cost: (1983 only)	-
Start Date:	May 1980	Completion Date:	January 1983
Project Manager:	D. Bolger, City of Calgary, Transportation Department, (403) 268-1631		
Dissemination of Results:	Copies of report available from City of Calgary, Transportation Department, P.O. Box 2100, Calgary, Alberta, T2P 2M5		

Project Objective, Scope, Background, and Methodology:

The objectives of this study were to determine the number and characteristics of Calgary's transportation handicapped population and to evaluate the supply of transportation based on current and future demand levels. The research methodology included major questionnaire and interview surveys of the handicapped population and their respective service agencies to obtain data on travel behaviour and transportation concerns/recommendations, an inventory of government, voluntary and private funding sources and transportation providers, and an operational review of the city-funded handibus and special needs taxi program. The final report summarizes these research activities and presents a number of recommendations to improve the effectiveness and cost-efficiency of service delivery with respect to regular transit and special parallel service.

Project Results/Conclusions/Preliminary Findings:

The study concluded that the effectiveness and cost-efficiency of parallel transportation service for the disabled could be improved by maximizing the use of lower cost - taxi based services. This was accomplished by transferring demand response service for the ambulatory handicapped from the handibus service to an upgraded subsidized taxi program.

Further Research Work Identified:

Evaluation of the taxi experiment is continuing.

Project Number:	210
Subject:	Operational Planning Studies - Disabled Transit
Submitted by:	Saskatchewan Urban Affairs

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Project Title:	Transit for the Disabled Survey		
Title of Report:	Transit for the Disabled Survey		
Funding Source(s) and % Share:	Saskatchewan Urban Affairs, (100%)		
Consultants/Contractors Used:	None		
Total Project Cost: (all years)	N/A	Total Project Cost: (1983 only)	N/A
Start Date:	June 1983	Completion Date:	September 1983
Project Manager:	B. Singh, (306) 565-2665		
Dissemination of Results:	Internal		

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Project Objective, Scope, Background, and Methodology:

The Saskatchewan Urban Affairs Department conducted a survey by asking participating municipalities to complete a questionnaire designed to find out problems faced by these municipalities respecting the vehicles used for transit for the disabled and implementation of the service in these smaller communities.

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Project Results/Conclusions/Preliminary Findings:

Minor difficulties with delivery of service and vehicles.

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Further Research Work Identified:

Project Number: 211
Subject: Land Use/Community Planning
Submitted by: Canada Mortgage and Housing Corporation

Project Title: Accessible Residential Communities for the Disabled

Title of Report: Accessible Residential Communities - Issues and Solutions

Funding Source(s) and % Share: Canada Mortgage and Housing Corporation, (100%)

Consultants/Contractors Used: Associated Planning Consultants Inc.

Total Project Cost: (all years) -
Total Project Cost: (1983 only) -

Start Date: -
Completion Date: -

Project Manager: Jeam-Remi Champagne, (613) 743-2365

Dissemination of Results: CMHC Research Report, copies available from CMHC information centre

Project Objective, Scope, Background, and Methodology:

Housing for disabled people cannot be successful unless it is located in physically accessible environments that provide ready access to shops, recreation, transportation, work and education opportunities, and essential community services and resources. Objective of the project was to identify the elements that are supportive of accessible housing (including transit) and to identify means of assuring that these will become a reality. It is primarily intended to assist the disabled consumer. Information was gathered from the available literature, a knowledgeable resource group, across-Canada trip to visit a variety of consumers and providers in five major regions, and the response to the broad distribution of a discussion paper.

Project Results/Conclusions/Preliminary Findings:

Access to facilities and services should be made possible through the interaction of accessible transportation, pedestrian systems, and sites. The exterior physical environment, transportation systems, buildings and facilities open to the general public should be accessible to and usable by disabled persons.

Further Research Work Identified:

None

Project Number: 212
Subject: Land Use/Community Planning
Submitted by: City of Calgary/Calgary Transit

Project Title: LRT Integration Study

Title of Report: LRT Integration Study

Funding Source(s) and % Share: Alberta Transportation, (66 2/3%)/City of Calgary, (33 1/3%)

Consultants/Contractors Used: McKellar Architects, Dr. John Morrall, University of Calgary

Total Project Cost: (all years) $12,000 Total Project Cost: (1983 only) -

Start Date: January 1, 1983 Completion Date: July 1983

Project Manager: D. Bolger, City of Calgary, Transportation Department, (403) 268-1631

Dissemination of Results: Reports available from the City of Calgary, Transportation Department, P.O. Box 2100, Calgary, Alberta, T2P 2M5

Project Objective, Scope, Background, and Methodology:

The purpose of the LRT Integration Study was to develop the concept of integrating LRT into a predominantly low density residential community and to formulate a number of principles related to both the design of the LRT system and the design of the community. The study is intended to provide a methodology for the integration of LRT into a community in Calgary where appropriate. It is not intended as a policy statement but as a support document that deals with how to integrate LRT into a suburban community.

Project Results/Conclusions/Preliminary Findings:

The LRT Integration Study has developed a "concept" and established parameters whereby LRT can be integrated into a residential community. The application of this concept will be adapted to the particular constraints and opportunities of a specific planning area. Where appropriate, elements of this study should be incorporated into Functional Studies, Community Plans and other planning documents that establish land uses and transportation systems for a specific geographic area.

Further Research Work Identified:

Further research is being done to determine what other cities have done to integrate rail systems with communities.

Project Number: 213
Subject: Transportation Planning Models
Submitted by: University of Calgary, Department of Civil Engineering

Project Title: Simulation of LRT and Bus Operation on the Calgary 7th Avenue Transit Mall

Title of Report: Computer Simulation of Surface Light Rail Transit Operation in a Mixed Traffic System

Funding Source(s) and % Share: University of Calgary, (80%)/City of Calgary, (20%)

Consultants/Contractors Used: None

Total Project Cost: (all years) $25,000 Total Project Cost: (1983 only) $12,000

Start Date: May 1981 Completion Date: December 1983

Project Manager: Dr. J.F. Morrall, Professor of Civil Engineering, University of Calgary

Dissemination of Results: Report submitted to the City of Calgary Transportation Department, P.O. Box 2100, Calgary, Alberta, T2P 2M5

Project Objective, Scope, Background, and Methodology:

The operational efficiency of LRT decreases as the degree of exclusivity of right-of-way declines. As a result, the efficiency of LRT operation in a mixed traffic system is usually impaired. The study objective was to develop a simulation model with which the operational behaviour of LRT, buses and other traffic can be examined under various operating strategies. The study included an intensive literature, search empirical study, model development, validation and experimentation stage. The model, called "Transitsm" was developed on the basis of the empirical study and the logic of operation on the 7th Avenue Calgary surface transit mall. This stochastic model was coded with over 3,500 computer statements in general purpose system simulation (GPSS) language.

Project Results/Conclusions/Preliminary Findings:

"Transitsm" is capable of replicating the existing traffic operation and thus, has a good predictive capacity. In view of the positive results obtained from the experimentation stage, it is evident that this model is a versatile tool for managing operations of LRT in a mixed traffic system.

Further Research Work Identified:

Possibility of incorporating Transitsm with a visual display unit and a model of global applicability should be sought. A GPSS language can be used to model LRT/Highway at-grade suburban intersection and other intersections.

Project Number:	214
Subject:	Transportation Planning Models
Submitted by:	Centre de recherche sur les transports

Project Title:	EMME/2 - An Interactive Graphic Urban Transportation Planning Method		
Title of Report:	An Interactive - Graphic Method for Road and Transit Planning		
Funding Source(s) and % Share:	NSERC, (50%)/FCAC, (30%)/Others, (20%)		
Consultants/Contractors Used:	Developped at the Centre de recherche sur les transports of the Université de Montréal		
Total Project Cost: (all years)	$750,000	Total Project Cost: (1983 only)	$100,000
Start Date:	May 1980	Completion Date:	Ongoing
Project Manager:	Michael Florian, (514) 343-7575		
Dissemination of Results:	TRB reports and presentations, Implementation in GVRD, Winnipeg, Montréal		

Project Objective, Scope, Background, and Methodology:

To develop an integrated multi-modal urban transportation planning method for use on a microcomputer or main frame computer that is interactive and uses graphics extensively. This method embodies all the latest developments in modeling road and transit route choice simulation, mode choice, and land use planning. The interactive - graphic code as well as the models and algorithm used are continuously enhanced. The method may be used for transit planning without need to consider the road network planning.

Project Results/Conclusions/Preliminary Findings:

The network has been implemented for use in Canada in Vancouver, Winnipeg, and Montréal. It is also being used in Stockholm, Sweden, and Portland, Oregon.

Further Research Work Identified:

Integration of demand model calibration interface and continuous improvement of the code.

Project Number: 215
Subject: Transportation Planning Models
Submitted by: M.M. Dillon Ltd.

Project Title: Enlargement of Motors Microcomputer Transportation Planning Package

Title of Report: Enlargement of Motors Microcomputer Transportation Planning Package

Funding Source(s) and % Share: M.M. Dillon Limited, (100%)

Consultants/Contractors Used: M.M. Dillon Limited

Total Project Cost: (all years) $15,000 Total Project Cost: (1983 only) $10,000

Start Date: July 1983 Completion Date: February 1984

Project Manager: R.J. Lewis/J.H. Sansom, (416) 229-4646

Dissemination of Results: Available from M.M. Dillon Ltd.

Project Objective, Scope, Background, and Methodology:

The application of microcomputers to transit planning is a relatively recent phenomena. The first generation of 8-bit micros generally had internal storage capabilities restricted to 64K bytes, which limited the size of urban or regional transit studies which could be undertaken. In the case of the Motors software package, the maximum study size was 100 zones, 600 nodes and 1000 links. With the advent of the 16-bit microcomputers (eg. the IBM-PC) having both greater RAM and increased external storage space (a hard disk drive), it is be possible to dramatically increase the study size capacity to enable transit studies, or multi-modal studies, for very large urban areas, to be undertaken on microcomputers.

Project Results/Conclusions/Preliminary Findings:

1) There is a trade-off between numbers of zones, nodes, links and stops in enlarging the capabilities of Motors.
2) Using 256K RAM and an external hard disk drive of 20 megabytes, it should be possible to model a transit system of 400 zones and 2000 links using an IBM-PC.

Further Research Work Identified:

Complete operational tests of enlarged version of Motors.

Project Number:	216
Subject:	Transportation Planning Models
Submitted by:	Joint Program in Transportation

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Project Title:	Modeling Urban Systems - A Gaming Approach		
Title of Report:	Modeling Urban Systems - A Gaming Approach		
Funding Source(s) and % Share:	Transport Canada Student Research Grant (100%)		
Consultants/Contractors Used:	P.M. Sarjeant, Researcher		
Total Project Cost: (all years)	$3,500	Total Project Cost: (1983 only)	-
Start Date:	May 1984	Completion Date:	-
Project Manager:	G.N. Steuart, Joint Program in Transportation, (416) 978-7282		
Dissemination of Results:	Joint Program Research Report		

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Project Objective, Scope, Background, and Methodology:

The goal of creating a comprehensive model of urban behaviour has never been satisfactorily achieved. This lack of success lies in the inability of the models developed using a systems approach to deal with the level of complexity inherent in an urban environment. This research program will constitute an exploration of the potential of modeling the behaviour of the primary actors within an urban area. The behaviour of interest is that which results in such phenomena as the markets for housing, employment, retail activity, and the associated demand for urban transportation. The ability to model such phenomena would provide a technique for forecasting changes in travel demand with respect to changes in the urban structure or environment, but also with a tool for exploring the possible results of various types of changes in planning strategies, municipal policies, etc. This work will differ from previous attempts in that it will be specifically directed at identifying the major elements of the system, identifying the interactions between the elements, and seeking to model the complexity of these interactions through the use of gaming model concepts.

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Project Results/Conclusions/Preliminary Findings:

Not yet available.

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Further Research Work Identified:

Project Number: 217
Subject: Transportation Planning Models
Submitted by: BC Transit

Project Title:	Transportation Modeling: 1) Sketch Model, 2) Regional Model, 3) Subarea Model, 4) Micro Model		
Title of Report:	None		
Funding Source(s) and % Share:	Per Capita Contribution from the Participating Municipalities		
Consultants/Contractors Used:	T. Partridge and Associates		
Total Project Cost: (all years)	$180,000	Total Project Cost: (1983 only)	$100,000
Start Date:	September 1982	Completion Date:	Ongoing
Project Manager:	D. King, Regional Development Officer, Greater Vancouver Regional District		
Dissemination of Results:	Results available upon request		

Project Objective, Scope, Background, and Methodology:

In September 1982, a Working Group on Transportation Modeling was formed with the purpose of establishing a forum for the discussion of modeling and forecasting issues in the Greater Vancouver and Greater Victoria regions. The general mandate of the Working Group is to "investigate the opportunities for the cooperative development and applications of transportation demand models in the Greater Vancouver and Greater Victoria areas". Work programs were developed and a number of modeling packages were reviewed. A new generation of model, EEME/2, was selected to be made operative in Greater Vancouver. At this point in the initial stages of model development, work programs ar being restructured to reflect the implementation of EMME/2.

Project Results/Conclusions/Preliminary Findings:

Based on a full comparison and evaluation, it was unanimously concluded that EEME/2 is the most suitable modeling package. Full accessibility of EMME/2 was ensured to all of the Working Group participants.

Further Research Work Identified:

The development of a comprehensive transportation model such as EMME/2 is an ongoing and task.

Project Number: 218
Subject: Transportation Planning Models
Submitted by: Centre de recherche sur les transports

Project Title: DSDM: Direct Spatial Demand by Mode

Title of Report: -

Funding Source(s) and % Share: SSRC, (80%)/Transport Canada, (10%)/Ministère de l'éducation du Québec, (10%)

Consultants/Contractors Used: -

Total Project Cost: (all years) $500,000
Total Project Cost: (1983 only) $60,000

Start Date: 1983
Completion Date: 1987

Project Manager: Marc Gaudry, (514) 343-7575

Dissemination of Results: C.R.T. reports and scientific journals

Project Objective, Scope, Background, and Methodology:

Development of a set of models to explain the Level or Market share of a transportation mode.

Project Results/Conclusions/Preliminary Findings:

Not yet available.

Further Research Work Identified:

Project Number:	219
Subject:	Transportation Planning Models
Submitted by:	Joint Program in Transportation

Project Title:	Dissaggregate Mode Choice Model for Metro Toronto Home-Based Work Trips		
Title of Report:	Dissaggregate Mode Choice Model for Metro Toronto Home-Based Work Trips		
Funding Source(s) and % Share:	Transport Canada Student Research Grant, (100%)		
Consultants/Contractors Used:	D.R. Ross, Researcher		
Total Project Cost: (all years)	$3,500	Total Project Cost: (1983 only)	-
Start Date:	May 1982	Completion Date:	May 1983
Project Manager:	G.N. Steuart, Joint Program in Transportation, (416) 978-7282		
Dissemination of Results:	Joint Program Research Report		

Project Objective, Scope, Background, and Methodology:

The objective of this research project is twofold; first to develop a data set suitable for discrete choice modelin of modal choice for work trips in Metropolitan Toronto, and second, to use the data set to study modal choice characteristics for home-based work trips using a dissaggregate multimodal logit model. Due to data limitations, the study will be conducted in two stages. The first will study non-CBD destined work trips using data collected i the 1980 Metropolitan Toronto Employee Travel Survey. If time permits, the second stage of the research will study the mode-choice characteristics of CBD destined work trips from data collected as part of the 1975 City of Toronto Central Area Parking and Loading Study.

Project Results/Conclusions/Preliminary Findings:

Further Research Work Identified:

Project Number: 220
Subject: Transportation Planning Models
Submitted by: City of Calgary/Calgary Transit

Project Title: Traffic Characteristics of Larger Suburban Offices

Title of Report: Trip Generation Study for Suburban Office Buildings

Funding Source(s) and % Share: Alberta Transportation, (66 2/3), City of Calgary (33 1/3%)

Consultants/Contractors Used: None

Total Project Cost: (all years) $17,700 Total Project Cost: (1983 only) -

Start Date: August 1980 Completion Date: December 1982

Project Manager: D. Bolger, City of Calgary, Transportation Department, (403) 268-1631

Dissemination of Results: Reports available from the City of Calgary, Transportation Department, P.O. Box 2100, Calgary, Alberta, T2P 2M5

Project Objective, Scope, Background, and Methodology:

Eight suburban offices were selected for a study of trip generation characteristics. The offices were selected in different areas of the city and adjacent to various levels of transit service. A series of counts were performed at each office generator to establish daily and peak hour vehicle and transit generation. Trip generation for each building was related to such variables as number of employees and floor area. An evaluation of parking requirements was also performed.

Project Results/Conclusions/Preliminary Findings:

The study provides additional information on the trip generation characteristics of suburban offices to supplement the I.T.E. trip generation manual.

Further Research Work Identified:

Project Number: 221
Subject: Transportation Planning Models
Submitted by: Transportation Development Centre

Project Title:	Canada Place Access Plan		
Title of Report:	Access Plan Review, Canadian Pavillion Canada Place, Expo 86		
Funding Source(s) and % Share:	Ministry of State for Social Development		
Consultants/Contractors Used:	G.D. Hamilton & Associates		
Total Project Cost: (all years)	$13,000	Total Project Cost: (1983 only)	$12,998.98
Start Date:	July 1, 1983	Completion Date:	October 1, 1984
Project Manager:	L. Suen, (514) 283-4100		
Dissemination of Results:	Limited copies available from sponsoring agency		

Project Objective, Scope, Background, and Methodology:

To assist the Federal Coordinator, Expo 86, CHPC, and the Canadian Government Exposition Centre in Transportation Planning and Demonstration of Advanced Circulation System on site and other related transportation technology. To develop a methodology to forecast originating and access modal split and to review transportation facility requirements at Canada Place. This project includes developing an originating and access modal split model, performing sensitivity and parametric analyses based on a range of attractivity factors and projected Expo 86 attendance scenarios. It includes discussion and liaison with site architects on transportation facility requirements. The review does not include the analysis of the future use of the Pavillion as a convention centre, nor the design of internal pavillion circulations systems.

Project Results/Conclusions/Preliminary Findings:

The study recommends that a secondary transportation connection be pursued between the Canadian pavilion and the west gate of the main site, and that a contingency plan be developed, in the unlikely event that the ALRT link fails to operate or is not completed on time.

Further Research Work Identified:

Design for the contingency link between the two Expo sites, also traffic engineering analysis for the entire Canada Place.

Project Number: 222
Subject: Transit Planning Models
Submitted by: University of Waterloo, Transport Group

Project Title: Historical Transit Indicators and Analysis

Title of Report: Several Internal Reports Available

Funding Source(s) and % Share: University of Waterloo, (90%)/National Science and Engineering and Research Council, (10%)

Consultants/Contractors Used: -

Total Project Cost: (all years) $2,000

Total Project Cost: (1983 only) -

Start Date: 1982

Completion Date: 1983

Project Manager: Judy Farvolden/J. Shortreed, (519) 885-1211

Dissemination of Results: -

Project Objective, Scope, Background, and Methodology:

Given the promise of the analysis in an earlier RTAC paper, i.e. that a policy model could be constructed for 5 year forecasts of subsidy, ridership, and costs. Data was collected from CUTA, and MTC. Satistics Canada and individual properties. This time service data is now ready for analysis.

Project Results/Conclusions/Preliminary Findings:

None yet.

Further Research Work Identified:

Project Number:	223
Subject:	Transit Planning Models
Submitted by:	University of Waterloo, Transport Group

- -

Project Title:	Transit Planning and Operations Model		
Title of Report:	Interbus Documentation		
Funding Source(s) and % Share:	National Science and Engineering Research Council, (100%)		
Consultants/Contractors Used:	Transport Group, University of Waterloo		
Total Project Cost: (all years)	$20,000	Total Project Cost: (1983 only)	$1,500
Start Date:	1980	Completion Date:	1983
Project Manager:	J. Shortreed, University of Waterloo, (519) 885-1211		
Dissemination of Results:	-		

- -

Project Objective, Scope, Background, and Methodology:

Development of micro-computer based interactive program for transit operations analysis and planning. Has three components: Demand estimation, supply characteristics, policy selection. Currently the program (Basic and CP/M) are working. The next step will be a case study application to a small transit system when funds are available.

- -

Project Results/Conclusions/Preliminary Findings:

Inter-bus set of programs are working and documented.

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Further Research Work Identified:

Case study application is hoped for if an interested transit property and some funding can be found.

Project Number: 224
Subject: Transit Planning Models
Submitted by: University of Waterloo, Transport Group

Project Title: Transit Demand Analysis

Title of Report: Applicability of Paratransit

Funding Source(s) and % Share: National Science and Engineering Research Council, (100%)

Consultants/Contractors Used: R. Tebinka, Masters Thesis

Total Project Cost: (all years) $12,000

Total Project Cost: (1983 only) -

Start Date: 1979

Completion Date: 1982

Project Manager: R. Tebinka/J. Shortreed, (519) 885-1211

Dissemination of Results: Published in RTAC Proceedings

Project Objective, Scope, Background, and Methodology:

Project objective was to develop a multinomial demand model for urban trips by 1) walk, 2) car driver, 3) car passenger, 4) transit, 5) taxi, 6) paratransit.

Project Results/Conclusions/Preliminary Findings:

Model successfully developed and used to evaluate several paratransit options. Model also validated against several data sets.

Further Research Work Identified:

Model appears to be very robust and would be applicable to the evaluation of new transit initiatives before implementation.

Project Number: 225
Subject: Transit Planning Models
Submitted by: Commission de transport de la Communauté urbaine de Montréal

Project Title: Conception and Development of Model Madituc

Title of Report: Integration du modèle Réseau de Madituc à l'Environnement de planification de la CTCUM

Funding Source(s) and % Share: CTCUM, CRSNG, and FCAC

Consultants/Contractors Used: None

Total Project Cost: (all years) $300,000
Total Project Cost: (1983 only) $35,000

Start Date: 1981
Completion Date: 1987

Project Manager: Robert Chapleau, (514) 877-6300

Dissemination of Results: Service de l'aménagement du réseau - CTCUM, interim reports

Project Objective, Scope, Background, and Methodology:

Conceive and develop a planning model for urban transit to suit the needs of transit officials responsible for establishing service levels and the measure of medium term impacts on demand and supply. Develop a range of programmes (Madituc - Dissaggregate Analysis Model of Urban Transit Schedules) according to a modal concept with th following functions. 1) Represent a large urban transit network; geometric classification, operational characteristics necessary to evaluate the resources, (fleet, vehicle hours, vehicle - kilometres). 2) Simulate the ridership distribution on the network using the O-D survey data. 3) Analyse, from different perspectives, the transit network market.

Project Results/Conclusions/Preliminary Findings:

In this specific sub-project, we are beginning the calibration of data which is to be incorporated in the model Reseau of the logic Madituc. Using survey data, we determine a procedure which characterizes (simultaneously) the limits of periods and service levels (average headways) which must be entered in the model to simulate the operations. The hypotheses are described in the report.

Further Research Work Identified:

See other parallel projects.

Numéro du Projet	225
Sujet:	Transit Planning Models
Soumis par:	CTCUM

Titre du projet:	Conception et développement du logiciel MADITUC		
Titre du rapport:	Intégration du module RESEAU de MADITUC à l'environnement de planification de la C.T.C.U.M.		
Source de financement et Pourcentage des coûts défrayés par chaque organisme:	C.T.C.U.M. (Commission de Transport de la Communauté Urbaine de Montréal), CRSNG et FCAC		
Consultants/Sous-traitants:	Aucune		
Coût total: (toutes les années)	$300,000	Coût total du projet: (1983 seulement)	$35,000
Le projet débute le:	1981	Fin du projet:	1987
Directeur du projet:	Robert Chapleau, (514) 877-6300		
Dissémination des résultats:	Service de l'aménagement du réseau, CTCUM, rapports de stage		

But, étendue, antécédents et méthodologie du projet:

Concevoir et développer un logiciel de planification de réseau de transport en commun adapté aux préoccupations des responsables de l'aménagement (établissement général du service, mesures d'impacts à moyen terme tant sur l'offre que sur la demande). Développer une suite de programme ordinés (système MADITUC-Modèle d'Analyse Désagrégée des Itinéraires en Transport Urbain Collectif), selon un concept de modularité, qui réalisent les fonctions suivantes: 1 - représenter un réseau de transport en commun de grande taille; codification géométrique et des caractéristiques opérationnelles afin d'en faire l'évaluation des ressources (flotte, véhicules-heures, véhicules-kilomètres). Simuler la distribution de l'achalandage sur le réseau à partir de données provenant d'enquêtes Origine/Destination. Analyser, selon différentes perspectives, la clientèle du réseau de transport en commun.

Résultats/Conclusions/Résultats préliminaires:

Dans ce sous-projet spécifique, on aborde la calibration des données qui doivent être incorporées au module RESEAU du logiciel MADITUC. A partir des données réelles (HORAIRES du réseau de référence, enquête 1982), on détermine une procédure caractérisant simultanément les limites de périodes et les niveaux de service (intervalles moyens) associés qui doivent être entrés dans le modèle afin d'en simuler les opérations. Les hypothèses sous-jacentes à l'évaluation agrégée des ressources sont décrites dans ce rapport.

Travail de recherche additionnel identifié:

Voir autres projets parallèles.

Project Number: 226
Subject: Transit Planning Models
Submitted by: Toronto Transit Commission

Project Title: Datacap

Title of Report: Datacap Evaluation Project

Funding Source(s) and % Share: Ontario Ministry of Transportation and Communications, (75%)/Toronto Transit Commission, (25%)

Consultants/Contractors Used: None

Total Project Cost: (all years) $240,000 Total Project Cost: (1983 only) $120,000

Start Date: 1983 Completion Date: 1984

Project Manager: P. Devereux/L.D. Jackson, Toronto Transit Commission, (416) 481-4252

Dissemination of Results: T.T.C. Management

Project Objective, Scope, Background, and Methodology:

To develop and evaluate a data capture and analysis system for route planning using hand held computer terminals. The information collected will be transmitted electronically to a central site to be aggregated and summarized by route.

Project Results/Conclusions/Preliminary Findings:

The first stage of the study which involved evaluating existing systems determined that none was sufficiently developed to be suitable for use by T.T.C. without extensive development work, thus, it was decided to develop a T.T.C. datacap system.

Further Research Work Identified:

Project Number: 227
Subject: Transit Planning Models
Submitted by: City of Calgary/Calgary Transit

Project Title:	Calgary Transit Ridership Variation Study		
Title of Report:	Calgary Transit Ridership Variation		
Funding Source(s) and % Share:	City of Calgary, (100%)		
Consultants/Contractors Used:	None		
Total Project Cost: (all years)	$1,000	Total Project Cost: (1983 only)	-
Start Date:	1982	Completion Date:	June 1984
Project Manager:	D. Bolger, City of Calgary, Transportation Department, (403) 268-1631		
Dissemination of Results:	Internal report only		

Project Objective, Scope, Background, and Methodology:

This project is designed to review daily and seasonal variations in transit ridership. The report will: 1) analyze existing ridership patterns; 2) establish the normal average level of observed ridership; 3) create an index relative to the normal level through which ridership levels for each day of the week may be estimated; 4) identify the effect that holidays and other specific events may have on overall ridership trends.

Project Results/Conclusions/Preliminary Findings:

Project results will indicate daily and monthly ridership fluctuations, as they exist, with current ridership calculation methods.

Further Research Work Identified:

N/A

Project Number: 228
Subject: Transit Planning Models
Submitted by: Ecole Polytechnique

- -

Project Title: Study of Productivity in Urban Transit Operations

Title of Report: Analysis and Modelling of Supply of Bus Services

Funding Source(s) and % Share: CRSNG

Consultants/Contractors Used: None

Total Project Cost: (all years) $80,000 Total Project Cost: (1983 only) $20,000

Start Date: 1977 Completion Date: -

Project Manager: Robert Chapleau, (514) 877-6300

Dissemination of Results: Masters Thesis by Richard Blouin, Ecole Polytechnique de Montréal

- -

Project Objective, Scope, Background, and Methodology:

Develop a computerized procedure for the introduction of a service (schedule production) using ridership counts fro maximum points on an urban transit line. Analyze the sensitivity of resulting impacts from the methods and standards now in use. Apply this procedure to actual data.

- -

Project Results/Conclusions/Preliminary Findings:

Two programs have been produced as a result of an analytical derivation to minimize costs. Analyses have shown the influence of certain factors; double counting, ratio of operation unit costs and waiting time. An integration wit the model Reseau de Madituc has been initiated.

- -

Further Research Work Identified:

Numéro du Projet 228
Sujet: Transit Planning Models
Soumis par: École polytechnique de Montréal

Titre du projet: Étude de la productivité opérationnelle d'un réseau de transport collectif urbain

Titre du rapport: Analyse et modélisation de l'offre de service d'une ligne d'autobus

Source de financement et Pourcentage des coûts défrayés par chaque organisme: CRSNG

Consultants/Sous-traitants: Aucune

Coût total: (toutes les années) $80,000

Coût total du projet: (1983 seulement) $20,000

Le projet débute le: 1977

Fin du projet: -

Directeur du projet: Robert Chapleau, (514) 877-6300

Dissémination des résultats: Thèse de maîtrise de Richard Blouin, École Polytechnique de Montréal

But, étendue, antécédents et méthodologie du projet:

Développer une procédure informatisée d'établissement du service (production de l'horaire) à partir de comptages ponctuels réalisés aux points de charge maximum des lignes de transport en commun. Analyser la sensibilité des impacts produits par les méthodes et les normes de service traditionnellement en usage. Appliquer cette procédure sur des données réelles.

Résultats/Conclusions/Résultats préliminaires:

Deux programmes (fusion des comptes et dérivation du service) ont été produits à partir d'une dérivation analytique complète du problème de minimisation des coûts (exploitant et usagers). Des analyses ont montrés l'influence d'éléments particuliers; double comptage, ratio des coûts unitaires d'exploitation et de temps d'attente. Une intégration au module réseau de madituc a été amorcée.

Travail de recherche additionnel identifié:

Project Number: 229
Subject: Transit Planning Models
Submitted by: University of Waterloo, Transport Group

Project Title: Impacts of Households Structure on Transit Ridership

Title of Report: -

Funding Source(s) and % Share: National Science and Engineering Research Council, (100%)

Consultants/Contractors Used: None

Total Project Cost: (all years) $13,000
Total Project Cost: (1983 only) $2,000

Start Date: 1981
Completion Date: 1983

Project Manager: N. Monkman/J. Shortreed, (519) 885-1211

Dissemination of Results: -

Project Objective, Scope, Background, and Methodology:

To use the Montreal Transit time series data to predict the impact of household structure changes on transit ridership.

Project Results/Conclusions/Preliminary Findings:

Transit ridership is heavily dependent on household structures and household structure can be predicted by a log linear model.

Further Research Work Identified:

None

Project Number: 230
Subject: Transit Planning Models
Submitted by: City of Calgary/Calgary Transit

Project Title: Transit Trip Generation Study

Title of Report: Transit Trip Generation Study

Funding Source(s) and % Share: City of Calgary, (100%)

Consultants/Contractors Used: None

Total Project Cost: (all years) $2,500 Total Project Cost: (1983 only) -

Start Date: 1982 Completion Date: 1984

Project Manager: D. Bolger, City of Calgary, Transportation Department, (403) 268-1631

Dissemination of Results: Internal circulation only

Project Objective, Scope, Background, and Methodology:

To determine up-to-date transit generation rates from various land uses (eg. residential, industrial). Specific land uses have been monitored to determine the transit ridership entering/leaving the defined zones.

Project Results/Conclusions/Preliminary Findings:

The project is intended to identify land use specific variations from the system wide transit generation rate.

Further Research Work Identified:

Project Number: 231
Subject: Transit Planning Models
Submitted by: University of B.C., Department of Civil Engineering

Project Title: Transit Fare - Revenue Study

Title of Report: Transit Fare - Revenue

Funding Source(s) and % Share: GVRD Transit Commission, (50%)/Civil Engineering, Transport Group, (40%)/National Science and Engineering Research Council, (10%)

Consultants/Contractors Used: None

Total Project Cost: (all years) $20,000 Total Project Cost: (1983 only) $3,000

Start Date: June 1982 Completion Date: June 1984

Project Manager: Dr. F. Navin, Department of Civil Engineering, U.B.C., Vancouver, British Columbia

Dissemination of Results: Copies of publications available from Dr. Navin

Project Objective, Scope, Background, and Methodology:

Develop a micro-computer program and model to (1) estimate transit ridership as a function of transit fares, (2) estimate suitable fare elasticities for Greater Vancouver's Transit riders, (3) present the results in a form suitable for presentation to transport decision makers.

Project Results/Conclusions/Preliminary Findings:

A computer model for an Apple II+ with 48 k, 1 disk drive, and printer. A method of proportioning elasticities between various fare collections systems; distance, time, time and distance.

Further Research Work Identified:

(1) A simple method to include the operating cost of ALRT in with Bus cost in the model. (2) Stratifying results to better understand the cross subsidies between city and suburbs.

Project Number: 232
Subject: Energy Management
Submitted by: Transportation Development Centre

Project Title: Urban Transportation Energy Management

Title of Report: A National Framework for Urban Transportation Energy Management

Funding Source(s) and % Share: Energy, Mines and Resources Canada, (43%)/National Energy Program, (57%)

Consultants/Contractors Used: IBI Group

Total Project Cost: (all years) $70,000

Total Project Cost: (1983 only) $40,000

Start Date: November 9, 1982

Completion Date: July 31, 1983

Project Manager: L. Suen, (514) 283-4100

Dissemination of Results: Copies available on request from sponsoring agency

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Project Objective, Scope, Background, and Methodology:

To develop a conceptual framework for urban transportation energy management (UTEM) based on the identification and assessment of existing and potential energy management measures, and on urban transportation systems characteristics, both passenger and goods. This study assesses the national energy impact of various urban transportation management measures taking into account the suitability of the measures by size of urban centre - an estimate of urban transportation system characteristics for various sizes of cities; - an estimate of urban transportation energy consumption by the various city sizes and the associated national urban energy consumption taking into account the total number of urban areas; a review of various transportation management measures and the associated energy impact - an evaluation of the ten best measures for each city size.

Project Results/Conclusions/Preliminary Findings:

A recommended program of research and development taking into account the potential energy savings of the various measures.

Further Research Work Identified:

Possible follow up with computerized traffic signal work and transportation information systems.

Project Number: 233
Subject: Energy Management
Submitted by: Transport Canada

Project Title: Urban Energy Modelling and Data Assessment

Title of Report: A Study of Energy Use in Urban Transportation

Funding Source(s) and % Share: Transport Canada, (100%)

Consultants/Contractors Used: Cusam Consultants, Carleton University

Total Project Cost: (all years) $29,818   Total Project Cost: (1983 only) -

Start Date: December 1983   Completion Date: March 1984

Project Manager: Dr. Lawrence May

Dissemination of Results: Transport Canada

Project Objective, Scope, Background, and Methodology:

The objective is to identify and examine the types of models available in the spectrum of urban energy use. Those models which are found to be applicable to the Canadian situation will be assessed on the basis of Transport Canada's needs in national urban energy use forecasting and in energy-related policy work; the statistical characteristics of the forecasts produced and finally, the input data requirements and implications for future data gathering.

Project Results/Conclusions/Preliminary Findings:

Not yet available.

Further Research Work Identified:

None as yet.

Project Number: 234
Subject: Energy Management
Submitted by: Queen's University

Project Title: Load Flow and Energy Management Studies

Title of Report: Load Flow and Energy Management Studies

Funding Source(s) and % Share: BILD Matching Research Grant

Consultants/Contractors Used: None

Total Project Cost: (all years) $32,000 Total Project Cost: (1983 only) $32,000

Start Date: March 1, 1983 Completion Date: February 28, 1984

Project Manager: G.E. Dawson with A.R. Eastham, V.I. John, P.C. Sen, Department of Electrical Engineering, Queen's University

Dissemination of Results: Report to Ministry of Colleges and Universities

Project Objective, Scope, Background, and Methodology:

This research grant is a matching grant based on research contract work done with the energy management model in the Department of Electrical Engineering, Queen's University for Metro Canada Ltd. The funds were granted to enhance and develop two areas of strength: the energy management computer modelling and the experimental facilities. The funds have been used to attract graduate students to work on improvements in the speed, accuracy, and capability of the energy management model.

Project Results/Conclusions/Preliminary Findings:

The energy management model has been enhanced through the use of the Newton-Raphson technique for the solution of the AC/DC network in the energy management model. In addition the model has been altered to accommodate both rotary and linear motor drives.

Further Research Work Identified:

Future research includes: new computer algorithms for the solution of AC/DC networks; the effects of converter induced harmonics into the power system and optimization techniques for energy minimization.

Project Number:	235
Subject:	Risk Analysis
Submitted by:	University of Waterloo, Transport Group

Project Title:	Risk Assessment of Transit Investment		
Title of Report:	Probabilities Framework for Evaluation of Transport Projects		
Funding Source(s) and % Share:	National Science and Engineering Research Council (70%)/University of Waterloo, (30%)		
Consultants/Contractors Used:	T. Mulligan, Masters Thesis		
Total Project Cost: (all years)	$12,000	Total Project Cost: (1983 only)	$2,000
Start Date:	1982	Completion Date:	1983
Project Manager:	T. Mulligan/J. Shortreed, (519) 885-1211		
Dissemination of Results:	Presently in Masters Thesis only. Paper being prepared		

Project Objective, Scope, Background, and Methodology:

Project objective was to apply probabilities methods to the evaluation of Rapid Transit Investment. The case study was the three proposed rail extensions in Toronto.

Project Results/Conclusions/Preliminary Findings:

The method clarifies the risks associated with large capital investments for transit. The evaluation of the case study indicates that there is more risk involved than indicated by earlier analysis.

Further Research Work Identified:

Project Number: 236
Subject: Risk Analysis
Submitted by: University of BC, Department of Civil Engineering

Project Title: Transit Ridership and Risk Analysis

Title of Report: Not known

Funding Source(s) and % Share: National Science and Engineering Research Council, (20%)/Civil Engineering, Transport Group, (80%)

Consultants/Contractors Used: None

Total Project Cost: (all years) $15,000

Total Project Cost: (1983 only) -

Start Date: March 1, 1984

Completion Date: March 1, 1985

Project Manager: Dr. F. Navin, Department of Civil Engineering, U.B.C., Vancouver

Dissemination of Results: Copies of publications from Dr. Navin

Project Objective, Scope, Background, and Methodology:

Using the procedures in risk-tree analysis estimate the travel reliability of transit. In particular, using published records of the failure rates of the Flyer-GM Trolley buses acquired by BC Transit and operated by Metro Transit Operating Company - Vancouver estimate the impact on mode choice.

Project Results/Conclusions/Preliminary Findings:

This should provide a good indication of reliability as a measure in transit made choice.

Further Research Work Identified:

POLICY AND PROGRAM DEVELOPMENT

Project Number: 237
Subject: Policy and Program Development - Regular Transit
Submitted by: Ontario Ministry of Transportation and Communications/Paterson Planning and Research Ltd.

Project Title: Coordination of Inter-Regional Transit Services - Greater Toronto Area

Title of Report: Inter-Regional Transit Coordination - A Working Paper

Funding Source(s) and % Share: Ontario Ministry of Transportation and Communications, (100%)

Consultants/Contractors Used: Paterson Planning and Research Limited

Total Project Cost: (all years) $38,000 Total Project Cost: (1983 only) $38,000

Start Date: December 1982 Completion Date: July 1983

Project Manager: David Smith - Policy Planning Branch, MTC

Dissemination of Results: Report distribution to agencies concerned with transit in the area. Copies available from MTC, Urban Transportation Policy Office

Project Objective, Scope, Background, and Methodology:

Inter-regional transit coordination in the greater Toronto area has been the subject of a number of previous studies. Transit ridership across the Metropolitan Toronto boundary has increased almost two-fold in the period between 1975 and 1981 and is expected to continue its rapid growth in the future. With the growing interdependence among the transit systems in the greater Toronto area, there is a growing need to coordinate their activities. The objective of the study is to determine the seriousness and extent of the problems or issues related to the provision of inter-regional transit services; suggestion of a range of alternatives and their implications, provision of a basis for MTC to initiate a discussion with various parties on a range of acceptable alternatives. Information on issues in transit coordination was obtained by means of a literature search. Supplementing this was information gathered from interviews conducted with 16 key agencies concerned with transit in the area.

Project Results/Conclusions/Preliminary Findings:

The study identified problems facing transit coordination in the study area. A range of alternative solutions for the problems and a framework for analyzing them were developed. The alternatives were then evaluated against a set of eleven criteria. The four most promising alternatives were then selected for further discussion among the affected parties.

Further Research Work Identified:

Selection of a workable alternative and preparation of an effective plan to implement it.

Project Number:	238
Subject:	Policy and Program Development - Regular Transit
Submitted by:	Ontario Ministry of Transportation and Communications/Paterson Planning and Research Ltd.

Project Title:	Coordination of Inter-Regional Transit Services - Greater Toronto Area		
Title of Report:	Inter-Regional Transit Coordination - An Implementation Plan		
Funding Source(s) and % Share:	Ontario Ministry of Transportation and Communications, (100%)		
Consultants/Contractors Used:	Paterson Planning and Research Limited		
Total Project Cost: (all years)	$31,515	Total Project Cost: (1983 only)	$26,000
Start Date:	September 1983	Completion Date:	January 1984
Project Manager:	David Smith - Policy Planning Branch, MTC		
Dissemination of Results:	Report distribution primarily to agencies concerned with transit in the area. Copies available from MTC, Urban Transportation Policy Office		

Project Objective, Scope, Background, and Methodology:

A previous study documented the current situation in the greater Toronto area with respect to inter-regional transit. Specific problems were identified, and a number of alternative solutions were proposed and evaluated. The four most promising alternatives were advanced for further consideration. The advantages and disadvantages of each were detailed as a basis for discussions between MTC and those concerned with inter-regional transit in the area. The purpose of the report was to recommend the most suitable way to improve coordination in the greater Toronto area, then to recommend an implementation plan to carry it out. The approach followed was to find the sound and workable solution to each problem which had the widest acceptance among the affected parties. To this end, a number of meetings were held with the affected parties, to discuss the previously released working paper. The key components of an effective implementation plan were then investigated and evaluated by the consultant.

Project Results/Conclusions/Preliminary Findings:

Evaluation of the four selected alternatives according to eleven criteria was made. Based on the consensus of the affected parties who responded to the previously released working paper, and on evaluation of the evidence by the consultant, the report recommended that MTC assume responsibility for inter-regional transit coordination in the area. In addition, there were 19 other recommendations concerning goals and objectives, the role of MTC, administrative organization, establisment of a transit forum, and monitoring results.

Further Research Work Identified:

The report suggested a work program for the short, medium, and long term, dealing with fare integration, routes, facilities, and other matters.

Project Number:	239
Subject:	Policy and Program Development - Regular Transit
Submitted by:	Ontario Ministry of Transportation and Communications

- -

Project Title:	Multi-Modal Interface Strategy - Greater Toronto Area		
Title of Report:	Multi-Modal Interface Strategy - Greater Toronto Area		
Funding Source(s) and % Share:	Ontario Ministry of Transportation and Communications, (100%)		
Consultants/Contractors Used:	IBI Group		
Total Project Cost: (all years)	$25,000	Total Project Cost: (1983 only)	$25,000
Start Date:	April 1983	Completion Date:	December 1983
Project Manager:	David Smith, Policy Planning Branch, MTC		
Dissemination of Results:	MTC		

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Project Objective, Scope, Background, and Methodology:

A need for better coordination of transit plans, activities, and services in the Greater Toronto Area has been identified. A key element in the coordination of services and activities is the development of a terminal, station or interface strategy. The identification of the transit interfaces is seen as a key element in the fostering of coordination between local, inter-regional and inter-city transit services and with the coordination of land use developments with the transportation services. The purpose of this study is to develop a transit interface strategy for the Toronto area. The objectives of the strategy are (1) to develop a classification system for existing and potential interfaces (2) to develop a strategic network of major interfaces and (3) to develop an implementation strategy for the major interfaces.

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Project Results/Conclusions/Preliminary Findings:

Consultant produced 3 technical memos (1) Transit Interface Strategy Study (2) Development of a Terminals Network (3) Implementation Strategy for Regional Transit Interface Terminals Network. A strategy summary is being produced.

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Further Research Work Identified:

None

Project Number:	240
Subject:	Policy and Program Development - Regular Transit
Submitted by:	Montreal Urban Community Transit Commission

Project Title:	Quality of Service at the MUCTC		
Title of Report:	Historical Analysis of MUCTC Policies Relative to Service Quality of Urban Transit		
Funding Source(s) and % Share:	MUCTC, (100%)		
Consultants/Contractors Used:	None		
Total Project Cost: (all years)	-	Total Project Cost: (1983 only)	-
Start Date:	September 1982	Completion Date:	June 1984
Project Manager:	André Arbic, (514) 877-6300		
Dissemination of Results:	Internal		

Project Objective, Scope, Background, and Methodology:

As a result, of the reviewing of certain policies, the MUCTC has decided to undertake the analysis of its past policies to resorient its future policies. The project aim is to evaluate using time-series starting in December 1956, the variation (evolution) of important variables which affect ridership.

Project Results/Conclusions/Preliminary Findings:

Should be available shortly.

Further Research Work Identified:

Numéro du Projet	240
Sujet:	Policy and Program Development - Regular Transit
Soumis par:	CTCUM

Titre du projet:	La qualité des services à la CTCUM		
Titre du rapport:	Analyse historique des politiques de la CTCUM relatives a la qualité des services de transport collectif urbain		
Source de financement et Pourcentage des coûts défrayés par chaque organisme:	CTCUM, (100%)		
Consultants/Sous-traitants:	Aucune		
Coût total: (toutes les années)	-	Coût total du projet: (1983 seulement)	-
Le projet débute le:	Septembre 1982	Fin du projet:	Juin 1984
Directeur du projet:	André Arbic, (514) 877-6300		
Dissémination des résultats:	-		

But, étendue, antécédents et méthodologie du projet:

Dans le cadre d'une réévaluation de certaines politiques, la CTCUM a entrepris de faire l'analyse de ses politiques passées pour pouvoir au besoin réorienter ses politiques futures. Le projet vise à évaluer à partir de séries chronologiques depuis décembre 1956 l'évolution des variables importantes qui influencent l'achalandage.

Résultats/Conclusions/Résultats préliminaires:

Le rapport devrait être disponible sous peu.

Travail de recherche additionnel identifié:

Project Number: 241
Subject: Policy and Program Development - Regular Transit
Submitted by: Montreal Urban Community Transit Commission

Project Title: Study on Service Standards

Title of Report: Inventory of Service Standards

Funding Source(s) and % Share: MUCTC, (100%)

Consultants/Contractors Used: None

Total Project Cost: (all years) -
Total Project Cost: (1983 only) -

Start Date: January 1983
Completion Date: December 1984

Project Manager: Françoise Grambin, (514) 877-6300

Dissemination of Results: Available on request

Project Objective, Scope, Background, and Methodology:

The MUCTC has undertaken the review of its service standards to re-evaluate the quality of its services as a function of availability of funds. The first phase was to prepare an inventory of existing standards at the CTCUM and to compare it with the industry in general.

Project Results/Conclusions/Preliminary Findings:

Report is available.

Further Research Work Identified:

Review the procedures for the application of each of the service standards in an operational context.

Numéro du Projet 241
Sujet: Policy and Program Development - Regular Transit
Soumis par: CTCUM

Titre du projet:	Étude sur les normes de service		
Titre du rapport:	Inventaire sur les normes de service		
Source de financement et Pourcentage des coûts défrayés par chaque organisme:	CTCUM, (100%)		
Consultants/Sous-traitants:	-		
Coût total: (toutes les années)	-	Coût total du projet: (1983 seulement)	-
Le projet débute le:	Janvier 1983	Fin du projet:	Décembre 1984
Directeur du projet:	Françoise Grambin, (514) 877-6300		
Dissémination des résultats:	Rapport disponible sur demande		

But, étendue, antécédents et méthodologie du projet:

La CTCUM a entrepris de revoir l'ensemble de ses normes de service pour réévaluer la qualité de ses services en fonction de ses disponibilités financières. La première étape consistait à faire un inventaire des normes existantes à la CTCUM et à le comparer avec ce qui se passe dans l'industrie en général.

Résultats/Conclusions/Résultats préliminaires:

Travail de recherche additionnel identifié:

Revoir les procédures d'application de chacune des normes de service dans un contexte opérationnel.

Project Number: 242
Subject: Policy and Program Development - Regular Transit
Submitted by: Toronto Transit Commission

Project Title: Transit Financing

Title of Report: Transit Financing

Funding Source(s) and % Share: Toronto Transit Commission, (100%)

Consultants/Contractors Used: None

Total Project Cost: (all years) $20,000 Total Project Cost: (1983 only) -

Start Date: 1984 Completion Date: 1984

Project Manager: J. Davies, Toronto Transit Commission, (416) 481-4252

Dissemination of Results: Public report

Project Objective, Scope, Background, and Methodology:

The purpose of the study is (1) to review the current capital and operating financial arrangements between the TTC, Metro Toronto and the Province (2) to identify and discuss issues and alternatives and (3) recommend a TTC position on the above for future discussions with all parties. Ten year capital spending scenarios will be developed including an assessment of the impact of these scenarios on Metro and the Province. The examination of operating subsidies will include an examination of the rationale for the current R/C ratio formula, the impact of the formula on current and future subsidy requirements. The assessment of the current formula based on specific criteria and the development of financing alternatives.

Project Results/Conclusions/Preliminary Findings:

Background reports completed. Final report currently being developed.

Further Research Work Identified:

N/A

Project Number: 243
Subject: Policy and Program Development - Regular Transit
Submitted by: University of Western Ontario, Department of Economics

Project Title: Capital Biased Subsidies, Bureaucratic Monitoring, and Bus Scrapping

Title of Report: Capital Biased Subsidies, Bureaucratic Monitoring, and Bus Scrapping

Funding Source(s) and % Share: Social Sciences and Humanities Research Council of Canada, (100%)

Consultants/Contractors Used: None

Total Project Cost: (all years) $2,100
Total Project Cost: (1983 only) -

Start Date: 1982
Completion Date: 1983

Project Manager: Dr. Mark Frankena, Department of Economics, University of Western Ontario

Dissemination of Results: Bureau of Economics, Federal Trade Commission, Washington, D.C., 20580, Working Paper #83

Project Objective, Scope, Background, and Methodology:

Capital subsidy policies have been criticized by economists as being excessive in that they provide an incentive for inefficient use of capital funds and facilities. The purpose of the project is to evaluate empirically the impact of capital based subsidy policies using the Ontario Subsidy for transit vehicles as an example. As well it was intended to demonstrate whether or not bureaucratic approval requirements are effective in preventing capital based subsidies from leading to the premature scrapping of buses.

Project Results/Conclusions/Preliminary Findings:

A model of bus scrapping behaviour indicates that capital subsidies will increase the scrapping probability and reduce the expected life for urban transit buses. Bureaucratic monitoring has not prevented premature scrapping of buses even for buses under 15 years old.

Further Research Work Identified:

None

Project Number:	244
Subject:	Policy and Program Development - Regular Transit
Submitted by:	Quebec Ministry of Transport

Project Title:	Car-Pooling		
Title of Report:	Preferential Treatment for High Occupancy Vehicles on Toll - Highways Headed for Montreal		
Funding Source(s) and % Share:	Quebec Ministry of Transport, (100%)		
Consultants/Contractors Used:	Canatrans Consulting/Transurb Inc.		
Total Project Cost: (1983 - 1984)	$70,000	Total Project Cost: (1983 only)	$12,500
Start Date:	1979	Completion Date:	1985
Project Manager:	Nguyen Quang Quy, (418) 643-1675		
Dissemination of Results:	-		

Project Objective, Scope, Background, and Methodology:

Objective is to develop a model of the car-pooling phenomenon to evaluate incentive measures. Similarly, it is intended to favour the development of car-pooling by establishing an appropriate policy.

Project Results/Conclusions/Preliminary Findings:

Have found a potential for toll-highways. Are now waiting for the decision of the ministries. Have also examined toll-free highways.

Further Research Work Identified:

Numéro du Projet	244
Sujet:	Policy and Program Development - Regular Transit
Soumis par:	Ministère des Transports du Québec

Titre du projet:	Covoiturage		
Titre du rapport:	Traitement préférentiel pour la circulation de véhicules à taux d'occupation élevé sur les autoroutes à péage		
Source de financement et Pourcentage des coûts défrayés par chaque organisme:	Ministère des Transports du Québec, (100%)		
Consultants/Sous-traitants:	Canatrans/Transurb Inc.		
Coût total: (1983-1984)	$70,000	Coût total du projet: (1983 seulement)	$12,500
Le projet débute le:	1979	Fin du projet:	1985
Directeur du projet:	Nguyen Quang Quy, (418) 643-1675		
Dissémination des résultats:	-		

But, étendue, antécédents et méthodologie du projet:

On veut arriver à une modélisation du phénomène covoiturage afin de pouvoir évaluer l'effet de mesures incitatives. De façon parallèle, on tente de favoriser le développement du covoiturage par l'établissement d'une politique appropriée.

Résultats/Conclusions/Résultats préliminaires:

On a identifié un potentiel sur les autoroutes à péage; on attend la décision des autorités ministérielles; on a également examiné les autoroutes sans péage.

Travail de recherche additionnel identifié:

Project Number: 245
Subject: Policy and Program Development - Regular Transit
Submitted by: Quebec Ministry of Transport

Project Title: Urban Parking

Title of Report: Parking Policies in Urban Areas to Promote Urban Transit

Funding Source(s) and % Share: Quebec Ministry of Transport, (100%)

Consultants/Contractors Used: None

Total Project Cost: (all years) $35,000 Total Project Cost: (1983 only) $30,000

Start Date: October 1982 Completion Date: February 1984

Project Manager: Paul Mackey, Michel A. Thivierge, (418) 643-1675

Dissemination of Results: Distribution to municipalities and urban transit operators

Project Objective, Scope, Background, and Methodology:

There is a costly competition between routes and urban transit. Parking is the pivot of the choice of a transportation mode. Municipalities have looked at it as a function of commercial and residential opportunities, since urban transit is the responsibility of supra-municipal agencies. This document attempted to encourage municipal administration to reflect on a parking policy which would favour urban transit, taking into account the financial equities, and improve quality of life in urban areas. An in-depth inventory of related publications from Canada, France, and the United States was used to find several ways to intervene.

Project Results/Conclusions/Preliminary Findings:

The 120 page report looks at the parking phenomenon, discusses possible objectives, and proposes different ways to take action. Zoning laws which ensure availability of parking contribute in a large part to low ridership for urban transit.

Further Research Work Identified:

Numéro du Projet	245
Sujet:	Policy and Program Development - Regular Transit
Soumis par:	Ministère des Transports du Québec

Titre du projet:	Le stationnement urbain		
Titre du rapport:	La conception du stationnement en fonction de l'économie urbaine		
Source de financement et Pourcentage des coûts défrayés par chaque organisme:	Ministère des Transports du Québec, (100%)		
Consultants/Sous-traitants:	-		
Coût total: (toutes les années)	$35,000	Coût total du projet: (1983 seulement)	$30,000
Le projet débute le:	Octobre 1982	Fin du projet:	Février 1984
Directeur du projet:	Paul Mackey, Michel A. Thivierge, (418) 643-1675		
Dissémination des résultats:	Publication envisagée; distribution aux municipalités et commissions de transport		

But, étendue, antécédents et méthodologie du projet:

Le Ministère des Transports subventionne le transport en commun et des projets routiers dans plusieurs municipalités en plus de réaliser lui-même des infrastructures routières. Or il existe une concurrence coûteuse entre la voiture et le transport en commun, dont il faut tenir compte. Le stationnement est le pivot du choix modal. Les municipalités l'ont abordé plutôt en fonction des commerces et des résidents, puisque le transport en commun est la responsabilité d'organismes supra-municipaux. Ce document vise donc à inviter les administrations municipales à réfléchir sur une politique de stationnement qui favorise le transport en commun, tient compte de l'équité financière et améliore la qualité de vie du milieu urbain. Un relevé approfondi de la littérature d'ici, de la France et des États-Unis a servi à mettre en lumière les nombreuses possibilités d'intervention.

Résultats/Conclusions/Résultats préliminaires:

Le rapport de 120 pages (avec 11 pages de bibliographie) examine le phénomène du stationnement, discute les objectifs possibles et dégage des propositions de mesures d'action, tout en respectant la responsabilité et l'initiative premières des municipalités. En particulier, les exigences de règlements de zonage pour assurer la disponibilité du stationnement et la nature gratuite de la majorité du stock expliquent, en grande partie, la faiblesse de l'achalandage du transport en commun.

Travail de recherche additionnel identifié:

L'approche nécessaire pour faire passer la préoccupation du stationnement au niveau municipal (subvention, expériences, pilotes).

Project Number: 246
Subject: Policy and Program Development - Regular Transit
Submitted by: University of Western Ontario, Department of Economics

Project Title: Regional Impacts of Trade and Transportation Policies

Title of Report: Regional Impacts of Trade and Transportation Policies

Funding Source(s) and % Share: Ontario Economic Council, (100%)

Consultants/Contractors Used: Professor J. Melvin, University of Western Ontario

Total Project Cost: (all years) $34,200
Total Project Cost: (1983 only) $15,000

Start Date: March 1983
Completion Date: November 1984

Project Manager: Douglas K. Crocker

Dissemination of Results: Publically available through government bookstores

Project Objective, Scope, Background, and Methodology:

The argument has often been made that Canadian tariff policies have not been neutral from region to region and has favoured central Canada and harmed the Maritimes and Western Canada. There is some controversy of the specific effects of tariff policies and little analysis on this subject. As well, there has been little analysis on inter-regional transportation policies and the interaction between tariffs and transportation costs. Purpose of the project is to examine the above including (1) an examination of the policy relevance for Ontario (2) a review of the relevant empirical and theoretical literature (3) the development of a series of simple models designed to capture the regional aspects of the Canadian economy and allow an evaluation of Canadian and Ontario economic policy options from a have not to have region.

Project Results/Conclusions/Preliminary Findings:

Tariffs result in product inefficiency and could produce inefficient interegional transportation Canadian tariff policies seem to be designed to make the economic system switch from collecting tariff revenue to using up resources in the production of unnecessary transportation. Tariffs could also result in welfare gains if they result in the reversal of the trade pattern and a switch in trading partners.

Further Research Work Identified:

Project Number: 247
Subject: Policy and Program Development - Disabled Transit
Submitted by: Transportation Development Centre

Project Title:	Aids for Cognitively Handicapped		
Title of Report:	1) Design Requirements for Technical Aids for the Mentally Handicapped 2) The Design and Development of Technical Aids for the Cognitively Handicapped		
Funding Source(s) and % Share:	National Research Council, (57%)/Transportation Development Centre, (43%)		
Consultants/Contractors Used:	Behavioural Team		
Total Project Cost: (all years)	$46,000	Total Project Cost: (1983 only)	Nil
Start Date:	July 6, 1982	Completion Date:	February 15, 1983
Project Manager:	R. Heron, (514) 283-4100		
Dissemination of Results:	Limited number available from National Research Council		

Project Objective, Scope, Background, and Methodology:

To seek ways of removing transportation barriers that restrict the mobility of Canada's physically and mentally handicapped persons. To provide a comprehensive documentation of the abilities, problems, and needs of cognitively handicapped persons in Canada and to produce a list of products and/or aids with the greatest potential for assisting this segment of the population.

Project Results/Conclusions/Preliminary Findings:

Preliminary findings - various lists were developed for various types of activity

Further Research Work Identified:

Project Number:	248
Subject:	Policy and Program Development - Disabled Transit
Submitted by:	Damas & Smith Ltd.

Project Title:	Transportation Planning for the Elderly		
Title of Report:	Transportation Planning for the Elderly		
Funding Source(s) and % Share:	Ontario Ministry of Housing, (100%)		
Consultants/Contractors Used:	Damas & Smith Limited		
Total Project Cost: (all years)	$21,000	Total Project Cost: (1983 only)	-
Start Date:	1981	Completion Date:	1983
Project Manager:	P. Wade, (416) 491-0111		
Dissemination of Results:	Ontario Ministry of Housing		

Project Objective, Scope, Background, and Methodology:

Project objective is to develop a plan to provide transportation for the elderly. Methodology involves a literature of similar studies in North America. Primary focus is on London and Kingston.

Project Results/Conclusions/Preliminary Findings:

The elderly are only one of many transportation underprivileged groups. The various groups should be considered together. The elderly are not as badly off as many other groups, with fairly good accessibility to transportation. The elderly tend to migrate to areas with better transportation services. Lack of basic information exists in Canada.

Further Research Work Identified:

More Canadian community studies are required. A policy of the level of acceptable service availability is required.

Project Number: 249
Subject: Policy and Program Development - Disabled Transit
Submitted by: City of Calgary/Calgary Transit

Project Title: Paratransit Feasibility Review

Title of Report: City of Calgary: Paratransit Feasibility Review

Funding Source(s) and % Share: Alberta Transportation, (66 2/3%)/City of Calgary, (33 1/3%)

Consultants/Contractors Used: City of Calgary Transportation Department

Total Project Cost: (all years) $25,000 Total Project Cost: (1983 only) -

Start Date: December 1982 Completion Date: April 1984

Project Manager: D. Bolger, City of Calagary, Transportation Department, (403) 208-1631

Dissemination of Results: Report available from: City of Calgary, Transportation Department, P.O. Box 2100, Calgary, Alberta, T2P 2M5

Project Objective, Scope, Background, and Methodology:

The purpose of the study is to review available operating experience and research with respect to paratransit development and to determine which concepts may have potential application as pilot projects in the City of Calgary. Five forms of paratransit are evaluated: dial-a-ride or dial-a-bus, shared-ride taxi, carpooling, van pooling and subscription bus services. The study draws upon Calgary's experience with respect to paratransit modes such as dial-a-bus and carpooling as well as surveys of other jurisdictions. To summarize the state-of-the-art with respect to paratransit development using a case study approach, the report concludes with an assessment of the applicability of each paratransit mode to the City of Calgary.

Project Results/Conclusions/Preliminary Findings:

Study recommendations to be presented for consideration by Calgary City Council in 1984.

Further Research Work Identified:

Project Number: 250
Subject: Policy and Program Development - Disabled Transit
Submitted by: City of Edmonton/Edmonton Transit

Project Title: Paratransit Services Study

Title of Report: Paratransit Services Study Final Report

Funding Source(s) and % Share: City of Edmonton, (100%)

Consultants/Contractors Used: None

Total Project Cost: (all years) -
Total Project Cost: (1983 only) -

Start Date: April 1983
Completion Date: December 1983

Project Manager: Mabula Sabula, City of Edmonton

Dissemination of Results: Transportation Department Senior Management, five working papers and final report prepared

Project Objective, Scope, Background, and Methodology:

Paratransit services provided for the general public are not new, but are showing a resurgence in many developed countries after peaking in the 1960's and mid-1970's and being abandoned thereafter because of low efficiency and productivity. The purpose of this study was to study the efficiency and effectiveness of replacing conventional fixed route - fixed schedule bus service in evenings, Monday to Saturday; and all day Sunday and holidays with some form of paratransit services in five communities of the City. The basic methodology involved comparing the cost of the quantity of service provided as it related to demand in a given area. The aim was to reduce service hours and vehicle kilometres operated by Edmonton Transit for paratransit.

Project Results/Conclusions/Preliminary Findings:

The project showed that paratransit services were more efficient and effective and could save money and provide the same or better service in low demand areas or time periods when compared with regular service. The cost savings for all the five areas was estimated at 40 percent. The service has been implemented in one of the areas since Novembe 1983. Expansion is expected in other areas in 1984.

Further Research Work Identified:

Paratransit services will be expanded into other areas of the City. An attempt will be made to develop quantitative criteria to determine when to replace regular service with paratransit services.

Project Number:	251
Subject:	Policy and Program Development - Disabled Transit
Submitted by:	City of Edmonton/Edmonton Transit

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Project Title:	Handicapped and Elderly Transportation Policy Study		
Title of Report:	Not known		
Funding Source(s) and % Share:	Alberta Transportation, (66%)/City of Edmonton, (33%)		
Consultants/Contractors Used:	None		
Total Project Cost: (all years)	$52,450	Total Project Cost: (1983 only)	-
Start Date:	January 1983	Completion Date:	April 1984
Project Manager:	D. Langille/S. Wilks, City of Edmonton		
Dissemination of Results:	Submission of action report to City council incorporating consumer and technical representatives concerns		

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Project Objective, Scope, Background, and Methodology:

The objective of the study is to review and develop a service policy strategy to satisfy, in a cost-effective manner, the current and future transportation needs of the handicapped and elderly in Edmonton. The study will: a) identify current unmet and latent demand, b) review jurisdictional responsibilities for the funding and provision of transportation services, and c) develop socially and financially acceptable policies within the framework of recognized municipal, provincial, and federal funding responsibilities and operationally and administratively feasible options for the delivery of transportation services to the handicapped and elderly transit market. Four working papers will be prepared prior to final report preparation. These will include a review of existing transportation services, policy, and funding responsibilities, a state-of-the-art review, an assessment of current and future services, policy and funding arrangements, and the generation and analysis of policy and service delivery options. The final recommendations will be prepared based on working paper results.

Project Results/Conclusions/Preliminary Findings:

Three working papers have been completed to date.

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Further Research Work Identified:

Project Number:	252
Subject:	Policy and Program Development - Disabled Transit
Submitted by:	Transport Canada

Project Title:	Investigation of Various Options Available for Urban Transportation Services for the Disabled		
Title of Report:	A Review of Urban Transportation Services for the Disabled Persons		
Funding Source(s) and % Share:	Transport Canada - Canadian Surface Transportation Administration, (100%)		
Consultants/Contractors Used:	Hickling Partners Inc.		
Total Project Cost: (all years)	$22,341.81	Total Project Cost: (1983 only)	-
Start Date:	June 1982	Completion Date:	March 1983
Project Manager:	A. Chandan, Chief, Policy and Analysis, Transport Canada, (613) 996-4180		
Dissemination of Results:	All members of Advisory Committee on Transportation of the Handicapped. Limited number of additional copies available from Transport Canada.		

Project Objective, Scope, Background, and Methodology:

One of the key issues in North America in providing transportation services for the disabled is whether their needs are better served through adaptation of conventional transit facilities or through provision of specialized transportation. The purpose of the study was to investigate the various transportation services available to disabled persons including: review of service options and their costs, investigation and on-site review of existing systems and technology, transportation problems experienced by disabled persons and scenarios for the future.

Project Results/Conclusions/Preliminary Findings:

The general conclusion was that if the aims of social integration, personal independence, human dignity and freedom of choice are to be combined with the existing objective of cost-effectiveness, then it would seem that the preferred policy option would be to emphasize the use of more personal forms of transportation for the disabled . That is to say, a variety of transport services should be encouraged but with the primary focus being the private automobile.

Further Research Work Identified:

Review of options for adapting and improving conventional transit services; definition of a set of operating guidelines for special transit services; develop cost estimates of special transit services in Canada; investigate feasibility and applicability of the brokerage concept in Canada.

TRAINING AND LABOUR RELATIONS

Project Number:	253
Subject:	Labour Relations
Submitted by:	Joint Program in Transportation

Project Title:	Labour Relations in the Canadian Urban Transit Industry		
Title of Report:	Labour Relations in the Canadian Urban Transit Industry		
Funding Source(s) and % Share:	Research Grant		
Consultants/Contractors Used:	D.F. Campbell, E. Dosman		
Total Project Cost: (all years)	-	Total Project Cost: (1983 only)	-
Start Date:	September 1983	Completion Date:	April 1984
Project Manager:	E. Dosman, Joint Program in Transportation, (416) 978-7282		
Dissemination of Results:	-		

Project Objective, Scope, Background, and Methodology:

After many years of labour peace, Canadian urban transit systems have experienced a high level of worker militancy over the past decade. During this period there has also been a sharp rise in labour costs, which account for the bulk of transit operating costs. Confronted by rapidly escalating transit deficits, policy-makers are giving increased attention to the search for ways to control the growth of labour costs while maintaining or improving collective bargaining relationships. Purpose of the project is to explain the increasingly complex industrial relations scene in recent years, examine the question of labour productivity and future prospects for labour/management relations in the Canadian transit industry. More specifically, the project will examine existing work rules, impact of work rule changes on labour costs include recruitment, absenteeism and turnover and at the ways in which different institutional structures affect transit labour relations.

Project Results/Conclusions/Preliminary Findings:

Not available.

Further Research Work Identified:

Project Number: 254
Subject: Absenteeism
Submitted by: Canadian Urban Transit Association

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Project Title:	Absenteeism		
Title of Report:	Report on Absenteeism		
Funding Source(s) and % Share:	Canadian Urban Transit Association, (100%)		
Consultants/Contractors Used:	None		
Total Project Cost: (all years)	-	Total Project Cost: (1983 only)	-
Start Date:	1982	Completion Date:	February 1984
Project Manager:	F. Rivest, Canadian Urban Transit Association, (416) 365-9800		
Dissemination of Results:	Available from 1983		

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Project Objective, Scope, Background, and Methodology:

Absenteeism among transit employees varies significantly from system to system. It is a costly expenditure which can be reduced, however, accurate and reliable statistics are required to monitor absenteeism both internally and in comparison to other transit systems. In response to the above, a standardized set of definitions was developed to collect absenteeism statistics and provide comparisons on a system by system basis. A semi-annual questionnaire was designed and distributed to all CUTA operating members.

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Project Results/Conclusions/Preliminary Findings:

Twenty-nine transit systems representing 19,891 employees responded. Average rate of absenteeism was 5.51% with operators having the highest rate of 6.57%. Rate of absenteeism due to sickness was 3.94% job related injury 0.71%, and personal leave 0.59%. The number of man days lost totaled 136,739 for the six month period ending December 31, 1983.

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Further Research Work Identified:

Survey will be repeated semi-annually.

Project Number: 255
Subject: Management Training
Submitted by: Transport Canada

Project Title: Developing Market Requirements for Transit Management Training Program

Title of Report: Urban Transit Management Education Program, Market Requirements Study

Funding Source(s) and % Share: Transport Canada, (100%)

Consultants/Contractors Used: IBI Group

Total Project Cost: (all years) $25,000 Total Project Cost: (1983 only) -

Start Date: July 1982 Completion Date: February 1983

Project Manager: A. Chandan, Chief, Policy and Analysis, Transport Canada (613) 996-4180

Dissemination of Results: All members of Training Steering Committee. Additional copies available from CUTA.

Project Objective, Scope, Background, and Methodology:

Following an extensive needs study, CUTA approved in principle the creation of a permanent transit management education and development program for the industry and recommended that requirements for such a program be investigated. The market requirements study surveyed CUTA members to gain an understanding of the effectiveness of present approaches and the needs and requirements for a CUTA-sponsored management education program. A training policy and management personnel questionnaires were distributed.

Project Results/Conclusions/Preliminary Findings:

The present approaches have not been entirely effective according to the majority of senior transit officials. Except for larger properties, management personnel agreed with this view. Management personnel in larger properties felt their management skills did not need upgrading except in areas related to efficiency and productivity. There is a need for a management education program with technical courses specifically oriented to the transit industry.

Further Research Work Identified:

Based on the work carried out in this study and the systems requirements study, the recommendations of these studies were presented to the CUTA Board of Directors who directed the Steering Committee to undertake work on developing a training program for senior, middle, and junior management levels.

Project Number:	256
Subject:	Management Training
Submitted by:	Transport Canada

Project Title:	Developing Systems Requirements for Transit Management Training Program		
Title of Report:	Urban Transit Management Education Program, Systems Requirements Study		
Funding Source(s) and % Share:	Transport Canada - Canadian Surface Transportation Administration, (100%)		
Consultants/Contractors Used:	Phaneuf, Gravelle, Blain and Associés Inc.		
Total Project Cost: (all years)	$29,500	Total Project Cost: (1983 only)	-
Start Date:	July 1982	Completion Date:	-
Project Manager:	A. Chandan, Chief, Policy and Analysis, Transport Canada (613) 996-4180		
Dissemination of Results:	All members of Training Steering Committee. Additional copies available from CUTA.		

Project Objective, Scope, Background, and Methodology:

Following an extensive needs study, CUTA approved in principle the creation of a permanent transit management education and development program for the industry and recommended that requirements for such a program be investigated. The systems requirements study examined the current state-of-the-art in transportation management programs in Canada and the U.S. through a literature search, interviews, and visits to transit properties, educational institutes, and private agencies.

Project Results/Conclusions/Preliminary Findings:

No Canadian institution presently offers transit oriented management programs. A separation should be made in the organization of such programs between senior and middle management on the one hand and junior level management or supervisors on the other. A modular program option was recommended.

Further Research Work Identified:

Based on the work carried out in this study and the market requirements study, the recommendations of these studies were presented to the CUTA Board of Directors who directed the Steering Committee to undertake work on developing a training program for senior, middle, and junior management level.

Project Number: 257
Subject: Operator Training
Submitted by: City of Calgary/Calgary Transit

Project Title: Operator Public Relations Training

Title of Report: Operator Public Relations Training

Funding Source(s) and % Share: Alberta Transportation, (100%)

Consultants/Contractors Used: Calgary Transit

Total Project Cost: (all years) $41,000 Total Project Cost: (1983 only) $41,000

Start Date: March 1983 Completion Date: December 1983

Project Manager: J.J. Heck, Calgary Transit, (403) 277-9711

Dissemination of Results: Report copies to Alberta Transportation and to all transit systems in Alberta

Project Objective, Scope, Background, and Methodology:

Objectives are to improve public relations skills of transit operators. 2) Evaluate effects of public relations training on accidents, sickness, and accident claims, late reports, complaints and commendations. During an economic downturn it is imperative that transit systems strive to retain existing riders and encourage additional riderships. In general, good marketing will be required, which can include active participation of those delivering the service (Transit Operators). 100 Operators would receive public relations/communications training (developed in-house). Their records (see Objective 2 above) would then be compared to operators who had not taken the training. In addition, their own impressions of the course and their attitude to the public would be gathered by survey after the course.

Project Results/Conclusions/Preliminary Findings:

The course was extended beyond the first 100. To date almost 500 have been trained. Those who have taken the course have averaged 69% less accidents 41% less S & A claims, 56% less S & A days, 9% less late reports, 19% less complaints and 23% less commendations in the period September - December 1983.

Further Research Work Identified:

Project Number: 258
Subject: Operator Training
Submitted by: Saskatchewan Urban Affairs

Project Title:	Safety Manual for Drivers of Disabled Transit Vehicles		
Title of Report:	Driver Safety		
Funding Source(s) and % Share:	Saskatchewan Safety Council, (100%)		
Consultants/Contractors Used:	Saskatchewan Safety Council		
Total Project Cost: (all years)	-	Total Project Cost: (1983 only)	-
Start Date:	1982	Completion Date:	N/A
Project Manager:	Harley P. Toupin, Saskatchewan Urban Affairs, (306) 565-2665		
Dissemination of Results:	-		

Project Objective, Scope, Background, and Methodology:

To develop a manual/handbook for use by drivers providing transit services for the disabled.

Project Results/Conclusions/Preliminary Findings:

Not yet completed.

Further Research Work Identified:

Project Number: 259
Subject: Other Training
Submitted by: City of Edmonton/Edmonton Transit

Project Title: Mentally Handicapped Transit Training Program

Title of Report: a) Summary Report, Mentally Handicapped Transit Training Program b) Phase 2 - Program Development and Recommendations

Funding Source(s) and % Share: Alberta Transportation, (66 2/3%)/City of Edmonton, (33 1/3%)

Consultants/Contractors Used: Edmonton Social Planning Council (Phase I)/The BISH Group Ltd. (Phase 2)

Total Project Cost: (all years) $38,025
Total Project Cost: (1983 only) -

Start Date: November 1980
Completion Date: April 1982

Project Manager: D. Langille, City of Edmonton

Dissemination of Results: Final report submitted to Commission Board and forwarded to Major's Office and Aldermen as information: Alberta Transportation; Coordinating Committee of Edmonton Interagency Council

Project Objective, Scope, Background, and Methodology:

The major objective of this project was to develop a transit training program for mentally handicapped individuals able to use public transit. The program was designed to be carried out in two phases. Phase I would determine the current need for a transit training program and update earlier 1978 findings of the Mentally Handicapped Transportation Study. Phase 2 would determine the potential scope and components of a transit training program for the development of an implementation strategy based on an evaluation of potential options. A review committee was formed to monitor and review the project and provide input throughout the two phases. Committee representation included the City of Edmonton Transportation Systems Design Department and Edmonton Transit, Alberta Social Services (Services for the Handicapped), Alberta Transportation, the Committee Chairman, and two others representatives.

Project Results/Conclusions/Preliminary Findings:

Phase I findings indicated sufficient need to warrant the development of a transit training program. Phase 2 recommendations proposed the development and implementation of a program option with a central management body and flexible training and monitoring features. The Project Coordinating Committee decided to try to obtain funding to develop a training manual, as the first step in implementing a transit training program.

Further Research Work Identified:

DATA COLLECTION AND ANALYSIS

Project Number:	260		
Subject:	General Statistics/Performance Indicators		
Submitted by:	Canadian Urban Transit Associaton		

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Project Title:	Uniform Transit Statistics		
Title of Report:	Not available		
Funding Source(s) and % Share:	Transport Canada, (100%)		
Consultants/Contractors Used:	To be selected		
Total Project Cost: (all years)	$25,000	Total Project Cost: (1983 only)	-
Start Date:	July 1984	Completion Date:	November 1984
Project Manager:	A. Chandan, Transport Canada, (613) 966-4180		
Dissemination of Results:	To urban transit industry, CUTA, Statistics Canada, Transport Canada		

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Project Objective, Scope, Background, and Methodology:

The project objective is to promote uniformity of urban transit financial and operating statistics in Canada, to increase the level of confidence in the transit data now available and allow for accurate comparisons between properties and to simplyfy the task of reporting data to associations and federal and provincial agencies. Phase I will involve the identification of those agencies collecting data, the purpose, method, frequency, analysis, and distribution of the data, definitions used, conflicting definitions, gaps and duplication in data collection and reporting, etc. Phase I will conclude with the identification of the lacking uniformity by data item and by agency. Phase II will involve the identification of alternative measures to achieve uniformity, a recommended set of base data and appropriate definitions and the development of an implementation strategy. The work of the consultant will be guided by a CUTA Steering Committee.

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Project Results/Conclusions/Preliminary Findings:

Not yet available.

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Further Research Work Identified:

Project Number:	261
Subject:	General Statistics/Performance Indicators
Submitted by:	Canadian Urban Transit Association

Project Title: Transit Fact Book

Title of Report: Urban Transit Facts In Canada - 1983 Edition

Funding Source(s) and % Share: Canadian Urban Transit Association, (100%)

Consultants/Contractors Used: None

Total Project Cost: (all years)	-	Total Project Cost: (1983 only)	-
Start Date:	January 1983	Completion Date:	August 1983

Project Manager: C. Wheeler, CUTA, (416) 365-9800

Dissemination of Results: Available from CUTA

Project Objective, Scope, Background, and Methodology:

Past CUTA fact books have included statistical data and definitions only with no narrative descriptions of the statistics. The purpose of this project was to expand the fact book to include a narrative description of the current status of the transit industry, the history of transit in Canada, and the benefits of urban transit services.

Project Results/Conclusions/Preliminary Findings:

Expanded fact book published in 1983 including statistics on disabled transit services.

Further Research Work Identified:

Project Number:	262
Subject:	General Statistics/Performance Indicators
Submitted by:	City of Calgary/Calgary Transit

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Project Title:	Transit Performance Indicators		
Title of Report:	Performance Indicators for Calgary Transit		
Funding Source(s) and % Share:	City of Calgary, (100%)		
Consultants/Contractors Used:	None		
Total Project Cost: (all years)	$4,000	Total Project Cost: (1983 only)	-
Start Date:	1981	Completion Date:	March 1984
Project Manager:	D. Bolger, City of Calgary, Transportation Department, (403) 268-1631		
Dissemination of Results:	Report - Internal Circulation, City of Calgary, Transportation Department, P.O. Box 2100, Calgary, Alberta, T2P 2M5		

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Project Objective, Scope, Background, and Methodology:

The Performance Indicator Report was initiated to identify measures of transit performance in Calgary. The report is based on a literature search of the state of transit performance indicators and attempts to apply principles inherent in the literature specifically to Calgary.

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Project Results/Conclusions/Preliminary Findings:

The report presents a set of route specific performance measures which result in a hierarchy of performance measures for transit operation in Calgary.

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Further Research Work Identified:

Project Number:	263
Subject:	Origin/Destination and Travel-to-Work Data
Submitted by:	Transport Canada

Project Title:	Analysis of Travel to Work Survey Data 1973-1981		
Title of Report:	Analysis of Travel to Work Survey Data 1973-1981		
Funding Source(s) and % Share:	Transport Canada, (100%)		
Consultants/Contractors Used:	None		
Total Project Cost: (all years)	-	Total Project Cost: (1983 only)	-
Start Date:	January 1983	Completion Date:	December 1983
Project Manager:	René Kehoe, Transport Canada, (613) 996-4180		
Dissemination of Results:	A report was distributed within Transport Canada and to Energy, Mines & Resources, Consumer and Corporate Affairs, and Statistics Canada		

Project Objective, Scope, Background, and Methodology:

The report provides a summary and analysis of the travel-to-work survey data collected between 1973 and 1981 and is comprised of three parts. Part I contains the main body of the analysis, part II the survey methodology and questionnaires used, and part III the raw data used in the analysis.

Project Results/Conclusions/Preliminary Findings:

The automobile dominates the journey to work in Canada. In 1981, approximately 73% of all commuters travelled to work by car while 16% used public transit and 10% walked. These proportions have fluctuated only slightly since 1973. For any trend to become apparent, a longer time span would be required. However, there is a reason to consider 1981 as a turning point since it was the first time there was a rise in the use of public transit by commuters and a drop in the use of private automobiles.

Further Research Work Identified:

Not all areas concerning the journey to work have been analyzed in the report. Further analysis related to energy consumption would be relevant in light of the high fuel costs in recent years.

Project Number:	264
Subject:	Origin/Destination and Travel-to-Work Data
Submitted by:	Transport Canada

Project Title:	Travel to Work Survey		
Title of Report:	Travel to Work Survey		
Funding Source(s) and % Share:	Transport Canada, (79%)/Energy, Mines & Resources, (21%)		
Consultants/Contractors Used:	Statistics Canada		
Total Project Cost: (all years)	$110,000	Total Project Cost: (1983 only)	$110,000
Start Date:	November 1983	Completion Date:	April/May 1984
Project Manager:	Janice Ife, Statistics Canada, (613) 992-7372		
Dissemination of Results:	Statistics Canada publication disseminated to universities, federal/provincial/municipal governments, and other interested parties		

Project Objective, Scope, Background, and Methodology:

The Travel to Work Survey is a supplementary survey added annually to the November Labour Force Survey and requests respondents to answer questions related to their journey to and from work. The objective of the survey is to develop a comprehensive data base on travel in urban areas as a means of monitoring changes in travel to work patterns and as input to policy formulation and urban transportation planning.

Project Results/Conclusions/Preliminary Findings:

Statistics Canada publishes an annual report on changes in urban travel patterns.

Further Research Work Identified:

None

Project Number: 265
Subject: Origin/Destination and Travel-to-Work Data
Submitted by: Quebec Ministry of Transport

Project Title: Research on the Characteristics Of Home Work Trips

Title of Report: Home-Work Trips in Quebec

Funding Source(s) and % Share: Quebec Ministry of Transport, (100%)

Consultants/Contractors Used: None

Total Project Cost: (all years) $40,000 Total Project Cost: (1983 only) $6,500

Start Date: May 1982 Completion Date: May 1984

Project Manager: Michel A. Thivierge/C.-Rodrigue Deschene, (418) 643-1675

Dissemination of Results: Publication and distribution of report to interested parties involved in urban transit

Project Objective, Scope, Background, and Methodology:

This study's objective is to determine the major characteristics of 3 modes: driving alone, car-pooling, and urban transit and to distinguish each of them relative to the others. The first part involves a study of the various transportation elements (accessibility of urban transit, vehicle ownership, length of trip, etc.) then, the perception and attitude characteristics using 8 attributes and a scale of 1 to 7 is evaluated. Finally, the socio-economic characteristics of transportation mode users is examined. To conduct the study four cities were choosen (Quebec, Montreal, Sherbrooke, and Chicoutimi - Jonquière). An area within each downtown was defined and employers were choosen at random to participate in the study. Analysis of the data included frequency analysis, analysis of variance (univariate and multivariate), discriminant analysis, factorial analysis, etc.

Project Results/Conclusions/Preliminary Findings:

Over 2100 questionnaires were completed and returned including 786 lone drivers, 553 car-poolers, 663 urban transit users, and 117 who used other modes. The results indicate little difference between users of different modes.

Further Research Work Identified:

It would be interesting to find the characteristics which are susceptible to influence the choice of modes in order to promote modes which would contribute to a more intermodal distribution of trip.

Numéro du Projet	265
Sujet:	Origin/Destination and Travel to Work Data
Soumis par:	Ministère des Transports du Québec

Titre du projet:	Recherche sur les caractéristiques des déplacements domicile-travail		
Titre du rapport:	Les déplacements domicile-travail au Québec		
Source de financement et Pourcentage des coûts défrayés par chaque organisme:	Ministère des Transports du Québec, (100%)		
Consultants/Sous-traitants:	N/A		
Coût total: (toutes les années)	$40,000	Coût total du projet: (1983 seulement)	$6,500
Le projet débute le:	Mai 1982	Fin du projet:	Mai 1984
Directeur du projet:	Michel A. Thivierge/C. Rodrigue Deschênes, (418) 643-1675		
Dissémination des résultats:	Publication d'un document et distribution aux intéressés du transport en commun, du covoiturage, des universités, etc.		

But, étendue, antécédents et méthodologie du projet:

Cette recherche a pour but de dégager les principales caractéristiques de trois modes de déplacement: la conduite seul, le covoiturage et le transport en commun et de les distinguer les uns par rapport aux autres. On y étudie d'abord les éléments de transport (accessibilité au transport en commun, propriété d'un véhicule, longueur du trajet, etc.) ensuite, on évalue les caractéristiques de perception et d'attitude selon huit attributs et à l'aide d'une échelle à sept niveaux. Enfin, on analyse les données socio-économiques des usagers des modes de transport. Pour effectuer cette recherche, on a identifié quatre villes du Québec, soit Montréal, Québec, Sherbrooke et Chicoutimi-Jonquière; on a par la suite délimité un quadrilatère au centre-ville et on a choisi au hasard des employeurs qui s'y trouvaient pour collaborer à la recherche. A l'aide de questionnaires complétés, on a analysé les résultats selon plusieurs volets; analyse de fréquences, analyse de variance univariée et multivariée, analyse discriminante, analyse de facteurs, etc.

Résultats/Conclusions/Résultats préliminaires:

Les premiers résultats indiquent, des 2119 questionnaires reçus et validés, 786 proviennent de conducteurs seuls, 553 de covoitureurs, 663 des usagers du transport en commun et 117 d'usagers de d'autres modes. De plus, 817 étaient de Montréal, 727 de Québec, 310 de Sherbrooke et 265 de Chicoutimi-Jonquière. En outre, les travaux effectués montrent que les usagers suivent des comportements qui leur sont particuliers mais que les différences entre eux d'un mode de transport à l'autre ne sont pas très grandes.

Travail de recherche additionnel identifié:

Il y aurait lieu de dégager les caractéristiques susceptibles d'influencer le choix d'un mode par rapport à un autre afin de promouvoir les modes qui peuvent contribuer à une répartition intermodale des déplacements plus efficace.

Project Number:	266
Subject:	Origin/Destination and Travel-to-Work Data
Submitted by:	Montreal Urban Community Transit Commission

Project Title:	Origin Destination Survey		
Title of Report:	Mobility of People in the Montreal Region		
Funding Source(s) and % Share:	MUCTC, (100%)		
Consultants/Contractors Used:	None		
Total Project Cost: (all years)	$35,000	Total Project Cost: (1983 only)	$35,000
Start Date:	September 1982	Completion Date:	December 1983
Project Manager:	Pierre Trottier, (514) 877-6300		
Dissemination of Results:	Report available upon request		

Project Objective, Scope, Background, and Methodology:

To establish a data-base for the planning of transportation systems in Montreal region. To build analytical tools for the proper management of the CTCUM system. Since 1970, the CTCUM has conducted 4 OD surveys of this type using a methodology adapted to the Montreal context. A copy of the method used in 1978 is available.

Project Results/Conclusions/Preliminary Findings:

Further Research Work Identified:

Results are used to analyse the evolution of the demand of each sector of the Montreal region.

Numéro du Projet	266
Sujet:	Origin/Destination and Travel to Work Data
Soumis par:	CTCUM

Titre du projet:	Enquête Origine-Destination		
Titre du rapport:	Mobilité des personnes dans la région de Montréal		
Source de financement et Pourcentage des coûts défrayés par chaque organisme:	CTCUM, (100%)		
Consultants/Sous-traitants:	Aucune		
Coût total: (toutes les années)	$35,000	Coût total du projet: (1983 seulement)	$35,000
Le projet débute le:	Septembre 1982	Fin du projet:	Décembre 1983
Directeur du projet:	Pierre Trottier, (514) 877-6300		
Dissémination des résultats:	Rapport disponible sur demande		

But, étendue, antécédents et méthodologie du projet:

Constituer une banque d'informations nécessaires à la planification des réseaux de transport dans la région de Montréal. Construire les outils analytiques requis pour gérer adéquatement le réseau de la C.T.C.U.M. Depuis 1970, la C.T.C.U.M. a exécuté quatre (4) enquêtes O-D de ce genre à partir d'une méthodologie adaptée au contexte de Montréal.

Résultats/Conclusions/Résultats préliminaires:

Travail de recherche additionnel identifié:

Les résultats sont utilisés pour faire l'analyse de l'évolution de la demande des secteurs de la région de Montréal.

Project Number: 267
Subject: Origin/Destination and Travel-to-Work Data
Submitted by: Montreal Urban Community Transit Commission

Project Title: Analysis of Results from 1982 Origin-Destination Survey

Title of Report: Analyse du Comportement des usagers de 1982 sous la perspective des modèles d'affectation

Funding Source(s) and % Share: MUCTC, (100%)

Consultants/Contractors Used: None

Total Project Cost: (all years) $15,000
Total Project Cost: (1983 only) $15,000

Start Date: September 1983
Completion Date: December 1983

Project Manager: Robert Chapleau, (514) 877-6300

Dissemination of Results: CTCUM Service de l'Aménagement du réseau

Project Objective, Scope, Background, and Methodology:

Since 1970, MUCTC has conducted O-D surveys to track travel patterns in its service areas. One of the objectives of this survey is to define the user characteristics and their trips for use by planners. The current study will identify with the use of the programme Transcom and the 1982 O-D survey data, the perception of riders of different service elements (waiting time, transfers, headways, type of service (bus, metro, train, etc.). Another part of the study will establish the survey bias by comparing survey results and actual ridership data.

Project Results/Conclusions/Preliminary Findings:

To the level of analysis possible with the aggreggate indicators supplied by Transcom, it has been found that: 1) waiting time is more evident in long than short headways 2) transfer time of about 5 minutes is not seen as negative 3) metro to metro transfers are viewed differently 4) the bias of the survey data is relatively high.

Further Research Work Identified:

Numéro du Projet	267
Sujet:	Origin/Destination and Travel to Work Data
Soumis par:	CTCUM

Titre du projet:	Analyse des résultats de l'enquête O-D 1982		
Titre du rapport:	Analyse du comportement des usagers de 1982 sous la perspective des modèles d'affectation		
Source de financement et Pourcentage des coûts défrayés par chaque organisme:	Commission de transport de la Communauté urbaine de Montréal, (CTCUM)/Transports Canada		
Consultants/Sous-traitants:	Aucun		
Coût total: (toutes les années)	$15,000	Coût total du projet: (1983 seulement)	$15,000
Le projet débute le:	Septembre 1983	Fin du projet:	Décembre 1983
Directeur du projet:	Robert Chapleau, (514) 877-6300		
Dissémination des résultats:	CTCUM, Service de l'Aménagement du réseau		

But, étendue, antécédents et méthodologie du projet:

Depuis 1970, la CTCUM réalise des enquêtes (Origine/Destination) pour mieux connaître les déplacements effectués sur son territoire. Un des buts de ces enquêtes est de chercher à caractériser le comportement des usagers afin de reproduire le mieux possible leurs déplacements, ceci à des fins de planifications. La présente étude consistait donc à caractériser, à l'aide du programme "Transcom" et des résultats de l'enquête O-D 1982, la perception qu'ont les usagers du transport en commun de différents composantes du réseau (temps d'attente et de correspondence, nombre et intervalles des lignes empruntées, types de lignes (autobus, métrobus, métro, train, etc.). Une autre partie de l'étude consistait à évaluer le biais de l'enquête à comparer les résultats de l'enquête à des comptes de voyageurs effectués par la CTCUM.

Résultats/Conclusions/Résultats préliminaires:

Au niveau d'analyses permis par l'étude des indicateurs agrégés fournis par "Transcom", il a été trouvé que: 1 - le coût en temps de l'attente semble s'apparenter plus à l'intervalle complet des lignes empruntées qu'au demi-intervalle; 2 - les usagers semblent affecter un coût non nul environs (5 minutes) au fait de correspondre, d'emprunter une ligne; 3 - ils considèrent différemment les correspondances métro-métro des autres types de correspondance; 4 - le biais de l'enquête semble être relativement élevé.

Travail de recherche additionnel identifié:

Project Number: 268
Subject: Origin/Destination and Travel-to-Work Data
Submitted by: Montreal Urban Community Transit Commission

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Project Title: Analysis of Origin-Destination Survey data (1970, 74, 78, 82)

Title of Report: Edudes des spécifications d'une interface entre le logiciel SAS et les données d'enquêtes origine/destination

Funding Source(s) and % Share: MUCTC, (80%)/Transport Canada, (20%)

Consultants/Contractors Used: None

Total Project Cost: (all years) $15,000 Total Project Cost: (1983 only) $15,000

Start Date: May 1983 Completion Date: September 1983

Project Manager: Robert Chapleau, (514) 877-6300

Dissemination of Results: CTCUM Service de l'Aménagement du réseau

- -

Project Objective, Scope, Background, and Methodology:

CTCUM carried out four origin-destination surveys between 1970 and 1982 requiring data analysis with computers. In order to build a computer interface between SAS (Statistical Analyst System) and this data bank, this report studies the data bank in general, the MUCTC data bank in particular and the internal structure of its files: variable observations and different methodologies from one survey to the other. SAS is briefly described and its characteristics most interesting for surveys are examined in detail. Finally, several examples of SAS show socio-economic-demographic analysis, mobility, trip generators, modal split and other miscellaneous analysis.

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Project Results/Conclusions/Preliminary Findings:

It was concluded that with the help of version 82.3 of SAS, supported by M.V.S. a practical and complete interface can be constructed and that the survey data available are sufficiently complete to generate model of specific transport needs of Montreal residents.

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Further Research Work Identified:

Development of an interface model in SAS macro language.

Numéro du Projet	268
Sujet:	Origin/Destination and Travel to Work Data
Soumis par:	CTCUM

Titre du projet:	Analyse des données d'enquêtes Origine/Destination (1970, 1974, 1978, 1982)		
Titre du rapport:	Étude des spécifications d'un interface entre le logiciel SAS et les données d'enquête Origine/Destination		
Source de financement et pourcentage des coûts défrayés par chaque organisme:	Commission de transport de la Communauté urbaine de Montréal, (CTCUM), 80% Transports Canada, (20%)		
Consultants/Sous-traitants:	Aucun		
Coût total: (toutes les années)	$15,000	Coût total du projet: (1983 seulement)	$15,000
Le projet débute le:	Mai 1983	Fin du projet:	Septembre 1983
Directeur du projet:	Robert Chapleau, (514) 877-6300		
Dissémination des résultats:	CTCUM, Service de l'Aménagement du réseau		

But, étendue, antécédents et méthodologie du projet:

La CTCUM a effectué quatre grandes enquêtes-ménages (Origine/Destination) entre 1970 et 1982, dont les résultats doivent être analysés par ordinateur. Dans le but de construire un interface informatique entre le logiciel de gestion et d'analyse de données choisi, SAS (Statistical Analysis System) et cette banque de données, ce rapport résume une étude sur la banque de données en général, celle de la CTCUM en particulier et la structure interne de ses fichiers; variables observations et différences méthodologiques d'une enquête à l'autre. Le logiciel SAS est brièvement décrit et ses caractéristiques les plus intéressantes par rapport aux enquêtes, appronfondies. Enfin, plusieurs exemples de programmes SAS démontrant des analyses de type socio-écono-démographiques, mobilité, génération des déplacements, répartition modale et quelques autres à sujets divers sont énumérés et expliqués.

Résultats/Conclusions/Résultats préliminaires:

On conclut qu'à l'aide de la version 82.3 du logiciel SAS, supportée sur M.V.S., un interface pratique et complet d'analyse des données d'enquêtes-ménages peut être bâti et que ces données sont maintenant suffisamment complètes pour accéder à la modélisation des besoins en transport spécifiques aux Montréalais.

Travail de recherche additionnel identifié:

Développement d'un interface, sous forme de modules en langage SAS macro.

Project Number:	269
Subject:	Origin/Destination and Travel-to-Work Data
Submitted by:	Joint Program in Transportation

Project Title:	1981 Census Data - Analysis for the Greater Toronto Area		
Title of Report:	1981 Census Data - Analysis for the Greater Toronto Area		
Funding Source(s) and % Share:	Ontario Ministry of Transportation and Communications, (100%)		
Consultants/Contractors Used:	University of Toronto/York University Joint Program in Transportation/University of Waterloo		
Total Project Cost: (all years)	-	Total Project Cost: (1983 only)	-
Start Date:	November 1983	Completion Date:	-
Project Manager:	G. Steuart, Joint Program in Transportation, (416) 978-7282		
Dissemination of Results:	-		

Project Objective, Scope, Background, and Methodology:

The most reliable and current information on the potential for work trips in urban areas in Canada is contained in the 1981 census relating the place of residence with the place of work. The 1981 information presents and opportunity to study how the pattern of work trips, or the opportunity for work trips, has changed over the ten year period. The objective of this research is to gain a better understanding of the relationships between place of work and place of residence in the Toronto area. Task 1: Design and implement a series of checks on the validity of the 1981 place of residence - place of work information. Task 2: Analyse the census tract to census tract connections in 1971 and 1981 for pattern changes in place of residence - place of work. Task 3: Evaluate the validity of distribution models such as frator and gravity model to forecast the 1981 connections from the 1971 connections. Task 4: Examine the 1971 to 1981 changes in the spatial distribution of place of residence - place of work connections for particular segments of the work force, i.e. occupation groupings. Task 5: Analyse the changes in characteristics of household structure.

Project Results/Conclusions/Preliminary Findings:

Not yet available.

Further Research Work Identified:

Project Number:	270
Subject:	Market Research
Submitted by:	Transport Canada

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Project Title:	Factors Influencing the Choice of Mode		
Title of Report:	Urban Transit Marketing Strategies		
Funding Source(s) and % Share:	TDC, (15%)/EMR, (15%)/Secretary of State, (8%)/MAS, (62%)		
Consultants/Contractors Used:	Secretary of State		
Total Project Cost: (all years)	$65,000	Total Project Cost: (1983 only)	$2,000
Start Date:	June 16, 1982	Completion Date:	November 31, 1983
Project Manager:	S. Corbeil/L. Parent, (514) 283-4100		
Dissemination of Results:	Distributed by the Secretary of State		

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Project Objective, Scope, Background, and Methodology:

Project objective is to improve the efficiency in terms of energy and traffic congestion of Canadian urban trnsit systems by providing incentives to use urban transit. The project will determine theoretical basis on which transit in Metropolitan Montreal should be promoted in the eyes of irregular users and in the eyes of non-users who own a car. The methodology included the analysis of the values and factors which significantly affect the choice of a transportation mode. These factors were then evaluated through a survey. A theoretical basis for a marketing campaign was then developed.

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Project Results/Conclusions/Preliminary Findings:

People prefer using their cars. Significant factors are; location of residence, service frequency, length of trip, waiting times and practical aspect. Non significant factors on which the promotion should concentrate to sensitize people are: cost, energy savings, reduced pollution, possibility to offer better service, economics of scale.

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Further Research Work Identified:

Numéro du Projet	270
Sujet:	Market Research
Soumis par:	Transport Canada

- -

Titre du projet:	Les facteurs influençant les citoyens de Montréal Métropolitain dans le choix des modes de transport		
Titre du rapport:	Stratégies de marketing du transport en commun		
Source de financement et pourcentage des coûts défrayés par chaque organisme:	CDT (15%) EMR (15%), S. d'E (8%) MAS (62%)		
Consultants/Sous-traitants:	Secrétariat d'État, Transport 2000, Transurb Inc.		
Coût total: (toutes les années)	$65,000	Coût total du projet: (1983 seulement)	$2,000
Le projet débute le:	16 juin, 1982	Fin du projet:	11 novembre, 1983
Directeur du projet:	S. Corbeil/L. Parent, (514) 283-4100		
Dissémination des résultats:	Distribution effectuée par le Secrétariat d'État		

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But, étendue, antécédents et méthodologie du projet:

Améliorer l'éfficacité, en termes d'énergie et de congestion, du système de transport canadien en incitant à l'utilisation du transport en commun dans les régions urbaines. Déterminer les bases théoriques sur lesquelles devraient reposer la promotion du transport en commun dans le Montréal métropolitain pour promouvoir l'idée du transport en commun chez l'usager non-régulier et surtout chez le non-usager propriétaire d'un véhicule automobile résidant dans la région Montréalaise. Le projet vise d'abord à effectuer une analyse des valeurs et facteurs significatifs dans le choix d'un mode de transport qui seront ensuite évalués sous la forme d'un sondage pour finalement développer des bases théoriques sur lesquelles devrait reposer une campagne de promotion pour le transport en commun.

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Résultats/Conclusions/Résultats préliminaires:

Stratégies de Marketing du Transport en Commun. Les usagers préferent nettement utiliser leur voitures. Les principaux facteurs déterminants sont: le lieu de résidence, la fréquence du service, la rapidité du parcours, les périodes d'attentes et l'aspect pratique. Les principaux facteurs non déterminants sur lesquels la promotion doit se diriger pour sensibiliser les gens sont: le coût, l'économie d'énergie, la réduction de la pollution et la possibilité d'offrir un meilleur service, plus économique à plus grande échelle.

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Travail de recherche additionnel identifié:

Non

Project Number: 271
Subject: Market Research
Submitted by: City of Calgary/Calgary Transit

Project Title: Advertising on Transit Products Feasibility Study

Title of Report: Advertising on Transit Products Feasibility Study

Funding Source(s) and % Share: Alberta Transportation, (66%)/City of Calgary, (33%)

Consultants/Contractors Used: None

Total Project Cost: (all years) $29,000
Total Project Cost: (1983 only) -

Start Date: -
Completion Date: -

Project Manager: Lisa Weber, Calgary Transit, (403) 277-9711

Dissemination of Results: -

Project Objective, Scope, Background, and Methodology:

To determine the feasibility of selling advertising space on Calgary Transit fare options and products. To determine the most cost effective of selling advertising, i.e. to manage a program internally or contract out.

Project Results/Conclusions/Preliminary Findings:

Not yet available.

Further Research Work Identified:

Project Number: 272
Subject: Market Research
Submitted by: Alberta Transportation

Project Title: Transit Marketing for Small Properties in Alberta

Title of Report: Transit Marketing for Small Properties in Alberta

Funding Source(s) and % Share: Alberta Transportation, (100%)

Consultants/Contractors Used: Intergroup Advertising Ltd.

Total Project Cost: (all years) $50,000 Total Project Cost: (1983 only) -

Start Date: January 30, 1984 Completion Date: April 1984

Project Manager: Lisa Weber, Calgary Transit, (403) 277-9711

Dissemination of Results: Report and probable implementation package to small transit properties

Project Objective, Scope, Background, and Methodology:

To determine through a marketing research program what the potential target for increasing ridership in each city* could be; and to prepare a marketing strategy and implementation plan. 1) Detailed research into existing ridership trends and transit market in each community; 2) Focus group analysis and telephone survey in each community to determine potential markets; and; 3) Marketing program and implementation package for small transit properties. *Cities included in study are Lethbridge, Medicine Hat, Red Deer, Grande Prairie, and Fort McMurray.

Project Results/Conclusions/Preliminary Findings:

Not yet available.

Further Research Work Identified:

Not known.

Project Number: 273
Subject: Market Research
Submitted by: Canadian Urban Transit Association

- -

Project Title: Gallup Poll Results

Title of Report: Gallup Poll Results - The Introduction of a $1.00 Coin in Canada

Funding Source(s) and % Share: Toronto Transit Commission, (100%)

Consultants/Contractors Used: Toronto Transit Commission

Total Project Cost: (all years) $2,200 Total Project Cost: (1983 only) $2,200

Start Date: September 1983 Completion Date: November 1983

Project Manager: C. Wheeler, Canadian Urban Transit Association, (416) 365-9800

Dissemination of Results: Results are available from CUTA

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Project Objective, Scope, Background, and Methodology:

The problem of $1.00 bills being deposited in fareboxes has become acute. CUTA has been urging the Royal Canadian Mint to introduce a $1.00 coin to alleviate the problems being experienced by transit operators. Public acceptance of the coin will be crucial if the coin is to minted and put into circulation. A survey of Canadians attitudes towards the introduction of a $1.00 coin both as a substitute and an alternative to the present dollar bill was initiated. A representative sample of 1,050 Canadian adults/18 years and older were personally interviewed in their homes. The design of the sample was based on the 1981 census of Canada.

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Project Results/Conclusions/Preliminary Findings:

35.1% would approve of the introduction of a $1.00 coin, 53.1% disapprove and 11.8% are undecided. The vast majority of those opposed suggest that they would be susceptible to persuasive arguments in favour of the coin's introduction. 26.0% approve of the introduction of a $1.00 coin and the withdrawl of the $1.00 bill, 66.3% disapprove and 7.7% were undecided.

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Further Research Work Identified:

Project Number: 274
Subject: Market Research
Submitted by: Toronto Transit Commission

Project Title: Variable Work Hours Program

Title of Report: 1) The Variable Work Hours Book 2) Variable Work Hours - A Survey of Downtown Toronto Emloyees

Funding Source(s) and % Share: Toronto Transit Commission, (100%)

Consultants/Contractors Used: None

Total Project Cost: (all years) $230,000 **Total Project Cost: (1983 only)** -

Start Date: 1981 **Completion Date:** Ongoing

Project Manager: A.J. Gallo, Toronto Transit Commission, (416) 481-7282

Dissemination of Results: Books, pamphlets given to employers, major media campaign

Project Objective, Scope, Background, and Methodology:

In March 1982, the TTC launched a promotional program designed to persuade Metro employers and employees to adopt variable work hours, that is, staggered or flexible start and finish times. The city's road and transit system are presently utilized to capacity for only a short period of time each day as employees travel to work for 8:30 or 9:0 start times. Shifts in arrival and quitting times of half an hour earlier or later can greatly ease congestion on the TTC, thereby reducing the need for increased expenditures in equipment and operations. The objectives of the promotional program are two-fold: employers are being asked to offer a variable work hours program so that employees have an option, and employees are asked to change their travel patterns to the off-peak. Pre-promotion research was carried out in early March to determine the status of variable work hours among downtown firms, particularly major employers in the area south of Bloor between Spadina and Sherbourne. Based on the above research, a marketing campaign was designed and implemented including the distribution of material to interested employers and radio, TV, newspaper, advertising.

Project Results/Conclusions/Preliminary Findings:

Surveys indicated that 4% of Metro employees had changed their travel patterns due to the variable work hours campaign.

Further Research Work Identified:

GENERAL TRANSPORTATION RESEARCH

Project Number:	275
Subject:	General Transportation Research
Submitted by:	Transportation Development Centre

- -

Project Title:	Urban Transit R & D Inventory		
Title of Report:	Not known		
Funding Source(s) and % Share:	TDC (38%), National Energy Program (35%), Department of Industry, Trade and Commerce, (27%)		
Consultants/Contractors Used:	Canadian Urban Transit Association, C. Wheeler, Research Coordinator		
Total Project Cost: (all years)	$71,000	Total Project Cost: (1983 only)	$35,000
Start Date:	September 1983	Completion Date:	May 1984
Project Manager:	L. Suen, (514) 283-4100		
Dissemination of Results:	To be distributed widely among CUTA membership and national agencies		

- -

Project Objective, Scope, Background, and Methodology:

The Canadian Urban Transit Association has been increasingly involved in urban transit R & D over the past several years including the approval of a position paper, the formation of an R & D Task Force, the preparation of a status report on R & D activities, and the creation of an R & D Coordinating Committee. This is in response to a growing need for coordination of urban transit related R & D projects especially information dissemination. The objective of this project is to publish an inventory of urban transit related R & D projects conducted, funded, and/or administered by transit operators, government agencies, universities, and suppliers of transit equipment and services. As well, the value of R & D outlined in the project inventory to the transit industry will be analyzed using a questionnaire and detailed discussions with a representative sample.

- -

Project Results/Conclusions/Preliminary Findings:

Over 400 agencies have been contacted for R & D information. Prelminary response indicates over 100 agencies are involved in conducting, funding, and/or administering urban transit related R & D projects over 400 projects have been documented.

- -

Further Research Work Identified:

Phase II involving an assessment of the R & D needs of the transit industry and the strategies and priorities required to address these needs is required. Provincial funding for Phase II is being requested by CUTA.

Project Number: 276
Subject: General Transportation Research
Submitted by: Douglas Whitehead Consulting

Project Title: Transportation Research in Quebec

Title of Report: Transportation Research in Quebec

Funding Source(s) and % Share: Quebec Ministry of Transport, (100%)

Consultants/Contractors Used: Douglas Whitehead Consultants

Total Project Cost: (all years) $56,500
Total Project Cost: (1983 only) $15,000

Start Date: August 1981
Completion Date: March 1983

Project Manager: Jean-Marc Rousseau, Centre de recherche sur les transports, (514) 343-1575

Dissemination of Results: Summary to all study participants and all attendees of AQTR 1983 conference. Available from L'Editeur officiel du Quebec

Project Objective, Scope, Background, and Methodology:

Objective is to prepare an inventory and analysis of all transportation research activities in Quebec including all manufacturers, consultants, government, universities, and carriers. This was done as the Quebec government was unsure of the current level of R & D activity but felt that problems existed. Methodology included an in depth questionnaire administered over the telephone, literature review, unstructured face to face interviews; analysis of all information.

Project Results/Conclusions/Preliminary Findings:

The lack of senior government funding of research especially demonstration projects is responsible for the limited scope of research activities. The problem is most acute in small properties as most existing research is oriented toward the Metro and is of a technological nature. Transit research does not enjoy wide political support and ther is little use of consultants.

Further Research Work Identified:

None specific to transit.

APPENDIX A

LIST OF APPENDICES		PROJECT NUMBER
A.1	Orion II - Technical Specifications and Seating Layout	6
A.2	Light Rail Mechanized Bogie	20
A.3	Transporter Passenger Vehicle	69
A.4	Disabled Trip Log Sheet	164

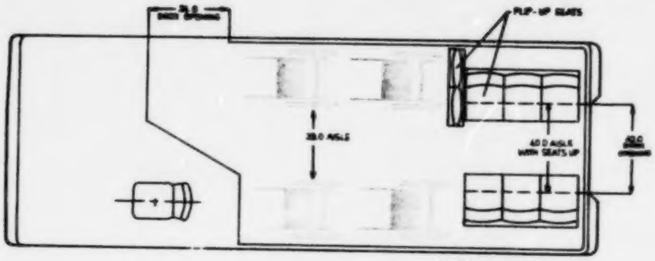
APPENDIX A.1 - TECHNICAL SPECIFICATIONS

Orion II

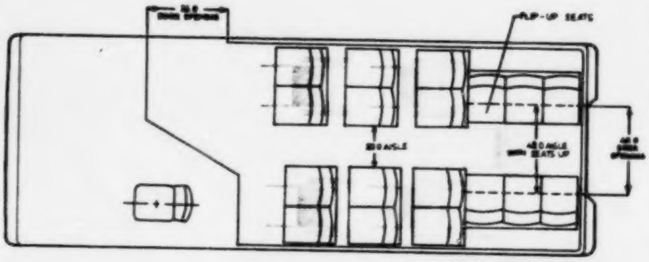
SPECIFICATIONS	**21' (6401mm)**	**25' (7620mm)**
Length	21' 11" (6680mm)	25' 11" (7899mm)
Width	96.0" (2438mm)	96.0" (2438mm)
Height	100.0" (2540mm)	100.0" (2540mm)
GVW	15,350 lb. (6963kg)	18,500 lb. (8392kg)
Engine	Cummins 4BT 390 105 HP (78.2kW) @2800 RPM	Detroit Diesel 8.2 Litre 130 HP (97kW) @2800 RPM
Transmission	Automatic Allison AT545	Automatic Allison AT545
Side Door	Adjacent Driver 36.0" x 77" (914mm x 1956mm)	Adjacent Driver 36.0" x 77" (914mm x 1956mm)
Rear Door..(Optional)	Rear Face of Bus 40.0" x 77" (1016mm x 1956mm)	Rear Face of Bus 40.0" x 77" (1016mm x 1956mm)
Seating Capacity	18 seated max. plus driver OR	26 seated max. plus driver OR
Wheelchairs (Forward Facing)	5 Random Access Wheelchair 7 Non Random Access Wheelchair	7 Random Access Wheelchair 10 Non Random Access Wheelchair
Body Structure	Stainless steel integrated structure	
Exterior Panels	Stainless steel and easily removable aluminum and fibreglass.	
Interior	RCA Rubber floor & melamine panelling.	
Heating System	80,000 BTU (20,161 KCal) combined front & rear	
Air Conditioning	45,000 BTU (11,341 KCal)	
OPTIONS		
Delete Air Cond.	Fresh Air Ventilation	
Rear Door	40" Opening (1016mm) Air Operated	
Destination Sign	Front Brow Mechanical or Electric	
Fare Box	Customer Specification	
Wheelchair Access		
Front	Ramp	
Rear (Opt.)	Ramp	
Floor Height "Normal Ride"	12.0" from ground (305mm)	
Floor Height "Kneeling" Front	8.0" from ground (203mm)	
Rear	3.6" from ground (91mm)	
Vehicle Propulsion	Front Wheel Drive Helical Reduction	
Brakes Front & Rear	15.5" x 6" (394mm x 152 mm) S-cam, Full air	
Lining Thickness	¾" (19mm)	
Suspension Front	Full Air, Beam Axle	
Rear	Full Air, Independent Trailing Arm.	
Wheels & Tires	(4) single tires 255/80R 22.5 on 10 stud hub mount wheels 22.5 x 7.50	
Steering	Integral power	
Wheel cuts	48°	

APPENDIX A.1 - SEATING LAYOUTS

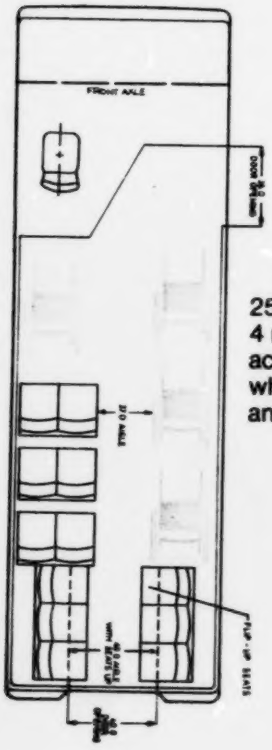
Orion II


FLIP-UP SEATS
40.0 AISLE WITH SEATS UP

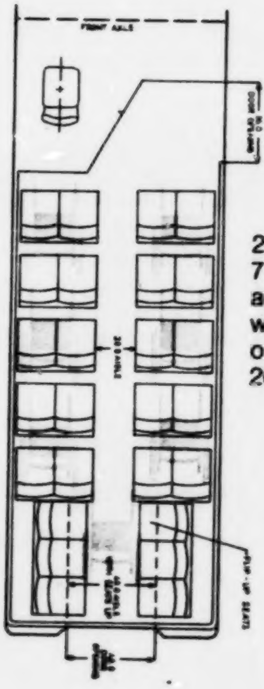
21′ ORION II
4 wheelchairs and 6 seats


FLIP-UP SEATS
40.0 AISLE WITH SEATS UP

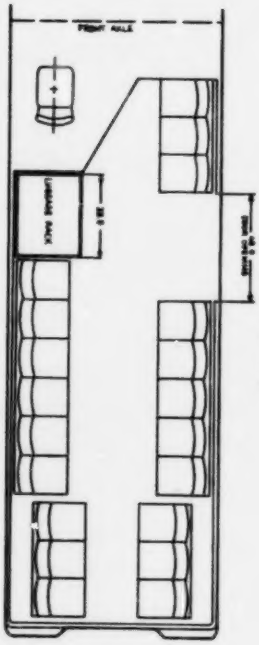
21′ ORION II
5 random access wheelchairs
or 18 seats


FRONT AXLE
FLIP-UP SEATS

25′ ORION II
4 random
access
wheelchairs
and 12 seats

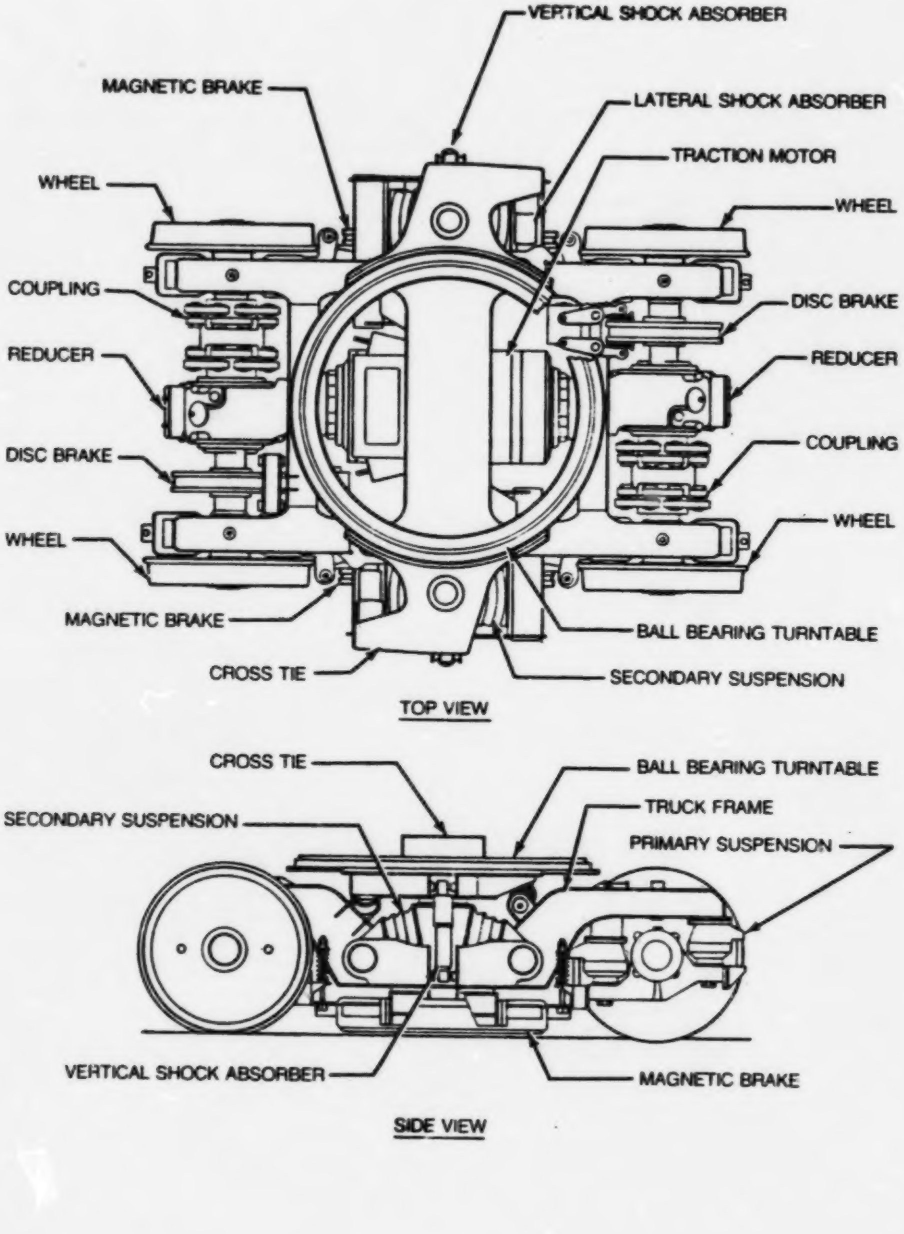

FRONT AXLE
FLIP-UP SEATS

25′ ORION II
7 random
access
wheelchairs
or
26 seats

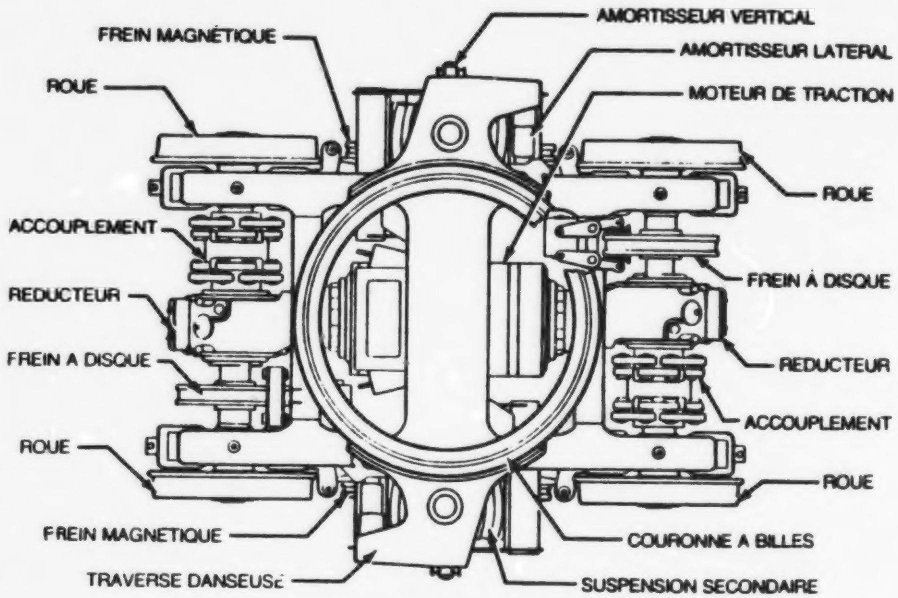

FRONT AXLE
LUGGAGE RACK

25′ ORION II
AIRPORTER
20 seats with
luggage rack
and wider
front door.

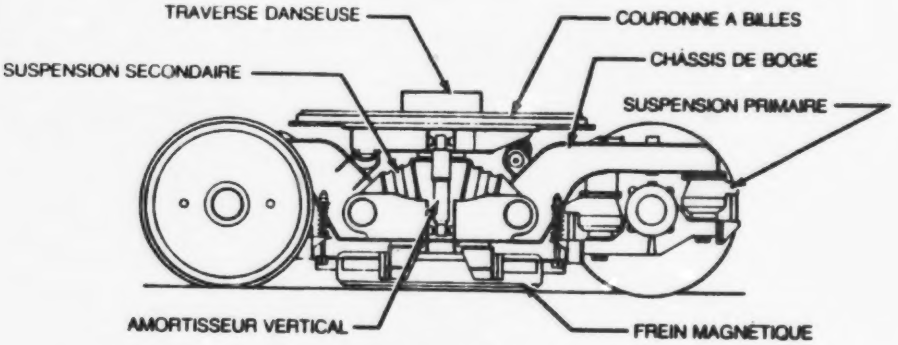
APPENDIX A.2 - LIGHT RAIL MECHANIZED BOGIE


VERTICAL SHOCK ABSORBER
MAGNETIC BRAKE
LATERAL SHOCK ABSORBER
TRACTION MOTOR
WHEEL
WHEEL
COUPLING
DISC BRAKE
REDUCER
REDUCER
DISC BRAKE
COUPLING
WHEEL
WHEEL
MAGNETIC BRAKE
BALL BEARING TURNTABLE
CROSS TIE
SECONDARY SUSPENSION
TOP VIEW
CROSS TIE
BALL BEARING TURNTABLE
TRUCK FRAME
SECONDARY SUSPENSION
PRIMARY SUSPENSION
VERTICAL SHOCK ABSORBER
MAGNETIC BRAKE
SIDE VIEW

APPENDIX A.2 - (CONT'D)

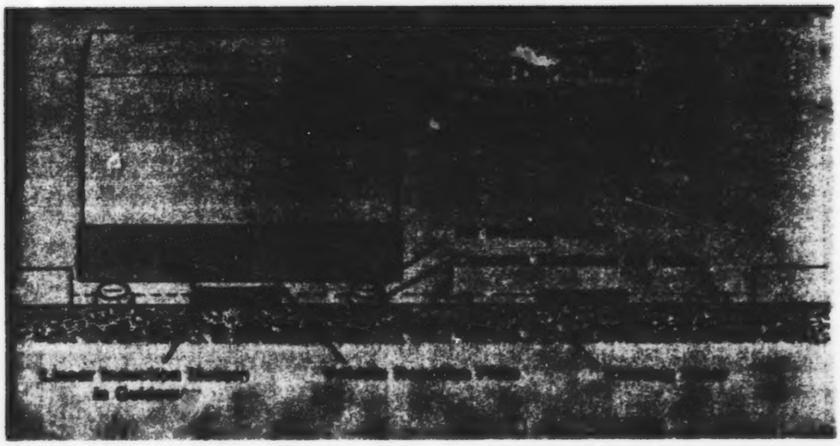

FREIN MAGNÉTIQUE
AMORTISSEUR VERTICAL
AMORTISSEUR LATERAL
ROUE
MOTEUR DE TRACTION
ROUE
ACCOUPLEMENT
FREIN À DISQUE
REDUCTEUR
REDUCTEUR
FREIN A DISQUE
ACCOUPLEMENT
ROUE
ROUE
FREIN MAGNETIQUE
COURONNE A BILLES
TRAVERSE DANSEUSE
SUSPENSION SECONDAIRE

VUE DE DESSUS

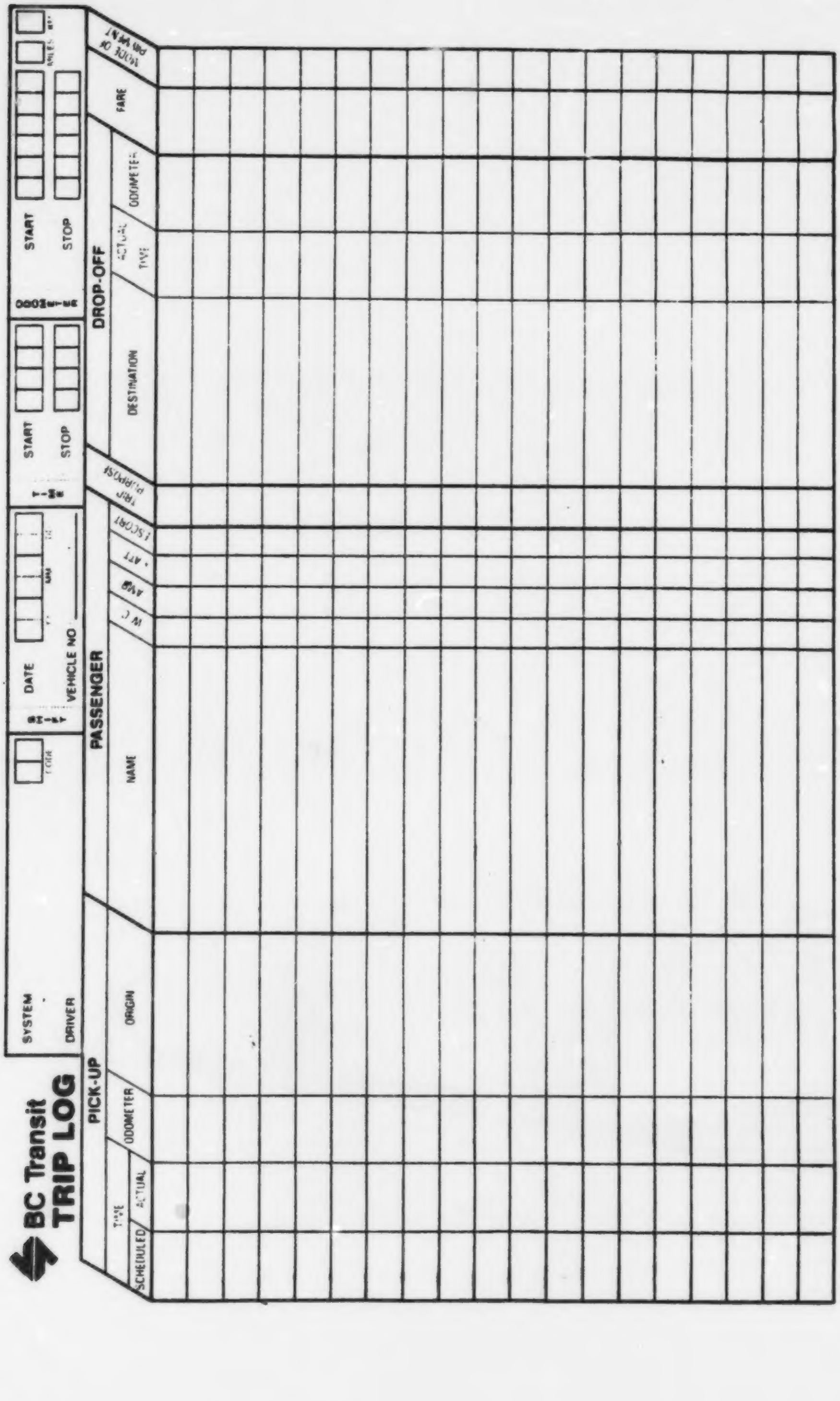

TRAVERSE DANSEUSE
COURONNE A BILLES
CHÂSSIS DE BOGIE
SUSPENSION SECONDAIRE
SUSPENSION PRIMAIRE
AMORTISSEUR VERTICAL
FREIN MAGNÉTIQUE

VUE DE FACE

APPENDIX A.3 - TRANSPORTER PASSENGER VEHICLE



APPENDIX A.4 - DISABLED TRANSIT TRIP LOG SHEET



BC Transit
TRIP LOG

SYSTEM
DRIVER
FORM
DATE
VEHICLE NO. ____
START
STOP
START
STOP

PICK-UP				PASSENGER						DROP-OFF			
TIME		ODOMETER	ORIGIN	NAME	W/C	AMB	+ ATT	ESCORT	TRIP PURPOSE	DESTINATION	ACTUAL TIME	ODOMETER	FARE	MODE OF PAYMENT
SCHEDULED	ACTUAL													

SECTION B

ANALYSIS OF VALUE OF URBAN TRANSIT R&D PROJECTS

SECTION B - ANALYSIS OF VALUE OF URBAN TRANSIT R & D PROJECTS

B.1 INTRODUCTION

Section B documents the views and perceptions of the Canadian transit industry concerning current R & D efforts in the urban transit sector. The desire to evaluate current industry R & D efforts resulted from concern that private and public R & D funds were being spent on projects which were not needed and/or not particularly relevant to the industry, especially transit operators.

The purpose of conducting an analysis of the value of current research efforts was threefold:

(1) to provide researchers with constructive feedback on their R & D efforts.
(2) to provide funding agencies with some guidance concerning their current commitment of R & D funds.
(3) to promote the conduct of R & D which more effectively addresses the needs and priorities of the transit industry.

B.2 VALUE ANALYSIS METHODOLOGY

Many techniques have traditionally been used to analyze the value of R & D activities. The techniques span the spectrum from simple ranking/rating models with minimal data requirements to complex programming models. Due to limited resources, the Canadian Urban Transit Association (CUTA) developed a simple methodology to evaluate each project described in Section A - Inventory of Urban Transit R & D Projects. The methodology used for the value analysis is described briefly below.

As shown in Table B.1, a number of evaluation criteria were developed so that the value of each R & D project could be properly assessed. The evaluation criteria range from the potential return or payback on the R & D expenditure, to how urgently the R & D product is needed by the industry. Obviously, a project may rank high in terms of one criterion and very low in terms of another. It was hoped that these wide ranging criteria would result in each project being thoroughly evaluated and that the sum of all the criteria ratings for a project would be truly representative of that projects' worth and value to the industry as a whole.

Using these evaluation criteria, respondents were asked to rank each R & D project using a 5-point rating scale as shown below.

SCORE	VALUE CATEGORY	DEFINITION OF VALUE
5	High Value	R & D activity is very significant and is of high value to the transit industry.
3	Moderate Value	R & D activity is significant and is of moderate value to the transit industry.
1	Low Value	R & D activity is not significant and is of little value to the transit industry.
0	No Value	R & D activity is of no value to the transit industry.

TABLE B.1

EVALUATION CRITERIA FOR VALUE ANALYSIS

BENEFIT POTENTIAL/PAYBACK ON INVESTMENT

Potential to contribute to industry goals of cost-effectiveness and productivity. Qualitative and quantitative benefits resulting from the R & D activity and/or the benefits associated with the implementation of the R & D product.

SCIENTIFIC POTENTIAL

Degree to which the R & D activity will advance scientific knowledge and the state-of-the-art and contribute towards the maintenance or establishment of Canadian leadership in the field.

TECHNICAL MERIT

Measure of the R & D activities technical merit i.e. is the methodology, approach and/or project objective technically significant.

UTILITY

What is the utility of the R & D activity including usefullness for further research, usefulness for policy making, and/or operational/administrative decisions?

TRANSFERABILITY

Can the results of the R & D activity be transferred to practice readily? Are there institutional, legislative, political, economic, and environmental obstacles to the effective implementation of the R & D product?

ORIGINALITY/SCOPE OF INTEREST

Is the R & D activity unique or is it being done or has it already been done by other industries/jurisdictions/agencies? Is the R & D activity of national interest or purely local?

URGENCY

A measure of the urgency of the R & D activity considering the lead time required for R & D and the timeframe before which R & D is required by the industry.

OVERALL VALUE

What is your overall perception or intuitive feel of the value of the R & D activity to the transit industry?

Next, respondents were asked to evaluate, in general terms, the value of their own R & D efforts, identify the obstacles to the conduct of more effective R & D and the potential solutions to these problems and to outline how R & D projects were selected for funding.

Finally, respondents were asked to indicate their degree of agreement/disagreement with a number of statements concerning the level of R & D, the value of R & D in broad subject areas, the value of R & D conducting by various types of organizations, the general benefits of research and methods for increasing the value of R & D in the urban transit industry as a whole.

B.3 RESPONSE TO VALUE ANALYSIS QUESTIONNAIRE

A representative sample of the industry was chosen to complete the value analysis questionnaire. As shown in Table B.2, 28 organizations were asked to complete the value analysis questionnaire including 7 government agencies (2 federal, 5 provincial), 14 transit operators (of various sizes and administrative arrangements), and 7 manufacturers and suppliers. CUTA staff explained the methodology to all respondents in face-to-face meetings with appropriate staff.

Unfortunately, due to the large amount of time required to complete the questionnaire and the voluntary nature of this activity, 11 organizations either declined to participate in the survey when contacted or indicated a willingness to complete the questionnaire but did not return a completed survey. This included 6 of the 7 suppliers asked to complete the questionnaire. The only supplier which responded to the questionnaire was Flyer Industries Inc. Since the original intent of the value analysis was to obtain the views and perceptions of the three main groups representing the transit industry (operators, government agencies, and suppliers), and since a sample of one is not representative, the questionnaire returned by Flyer Industries Inc. is excluded from the results which are described in this report. Consequently, the results documented in this section include the questionnaires completed by 5 of 7 government agencies, 11 of 14 transit operators and 0 of 7 suppliers. This represents a response rate of 57.1%. If the questionnaire returned by Flyer Industries Inc. is included, the response rate to the survey itself is 60.7%.

B.4 ACCURACY AND RELIABILITY OF DATA

While there is considerable literature on the evaluation of R & D activities, it should be noted that there are a number of problems and limitations associated with this type of analysis. In particular, there are problems associated with objectively evaluating the value of individual R & D projects.

Research, whether it be basic or applied, is usually performed to advance understanding in a given area. While such research is necessary for more directed development and eventually demonstration, the research itself may not be directly related to a particular development opportunity and the development and demonstration of a particular product or service may not result in innovation or change. For instance, R & D can result in the acquisition of new knowledge, contribute to an organization's overall strategy or objective, increase a company's competitive edge in the marketplace or in the case of the transit operator, make it more efficient and more effective. On the other hand, R & D may not produce any immediate scientific, technological or policy opportunities but may lead to later benefits. Consequently, the following general problems should be kept in mind when using the data presented in the following pages.

TABLE B.2

LIST OF CONTACTS FOR VALUE ANALYSIS

GOVERNMENT AGENCIES

Federal (2)

Transport Canada
National Research Council*

Provincial (5)

BC Transit
Alberta Transportation
Ontario Ministry of Transportation and Communications
Quebec Ministry of Transport
Nova Scotia Department of Municipal Affairs*

TRANSIT OPERATORS (14)

Toronto Transit Commission
Commission de transport de la Communauté urbaine de Montréal
Winnipeg Transit*
Calgary Transit
Metro Transit Operating Company - Vancouver
Commission de transport de la Communauté urbaine de Québec
The Hamilton Street Railway Company*
OC Transpo
Mississauga Transit
Regina Transit
Metro Transit Commission (Halifax/Dartmouth)
Commission de transport de la Communauté régionale de l'Outaouais*
Lethbridge Transit
Corporation municipale de transport de Sherbrooke

MANUFACTURERS/SUPPLIERS (7)

Urban Transportation Development Corporation*
Bombardier Inc.*
General Motors of Canada Limited*
Flyer Industries Inc.
Ontario Bus Industries Inc.*
Teleride/Sage Corporation*
James F. Hickling Management Consultants*

*Declined to participate or no reply received.

1) Defining "success" for a given R & D project or program is very difficult. The loose linkages between outcomes and specific product, policy, service or process improvements makes the evaluation of research extremely difficult.

2) The multiple responsibilities, issues, impacts, objectives, etc. of a particular R & D effort makes the design of an evaluation methodology which satisfies the technical, political, economic, institutional, and personnel values of various groups extremely complicated.

3) When using qualitative analysis, objectivity cannot be achieved and conclusions are inherently biased. Value analysis must be recognized as the product of the organization who is collecting, sorting, and analyzing the data to make a point.

4) As the Project Inventory was used as the basis for the value analysis, the quality and length of the project descriptions will be a large factor in an individual's evaluation of a specific project. If a project is described poorly, the evaluation of the project may suffer for no other reason than not enough information was supplied. As well, some projects were finished with documented results while others were in their infancy with only speculative results and conclusions. Again this will affect the evaluation of an individual project.

5) In some cases, due to time constraints, several individuals completed the questionnaire on behalf of a single organization. As a result, the consistency of the evaluations may be suspect.

6) Selecting a representative sample of the membership of the Association has been done rather arbitrarily. Although it is anticipated that the sample is roughly representative, no specific criteria were used in the selection of survey respondents.

7) The quality of the responses was entirely dependent on the goodwill of those individuals completing the value analysis. It is obvious that the amount of time spent completing the questionnaire has varied considerably from respondent to respondent.

Despite the above limitations, it is generally recognized that the best procedure for evaluating research is one in which peer and other technical experts judge intuitively the value of the R & D activity. (1) In any case, the results are useful as a guide for researchers and government agencies on the effectiveness of their efforts.

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(1) Source: Mitre Corporation, The Evaluation of Federal Research Programs, Mitre Technical Report, MTR 80 W129, McLean, Virginia, June 1980.

B.5 VALUE OF RESPONDENTS OWN R & D EFFORTS

Of the 16 respondents, 12 indicated they were currently involved in conducting, funding, and/or administrating urban transit related R & D projects. In evaluating their own R & D efforts, only 1 of the 12 respondents involved in R & D indicated that their own R & D efforts were low in value. All the remaining respondents rated their own R & D efforts as moderate or high in value. When comparing the value of their own efforts to other organizations of similar size, 2 respondents felt that their particular organizations efforts were more valuable than others while the remainder stated their own efforts were about the same as others.

As shown in Table B.3, transit operator respondents rated themselves higher on benefit potential/payback on investment, utility and urgency than on the remaining criteria. Government agency respondents evaluated their own R & D efforts in a similar fashion although they consistently rated the value of their own R & D efforts as higher than transit operators.

Related to the above are the responses concerning the obstacles to more effective R & D. As shown in Table B.4, the obstacles and proposed solutions are in line with CUTA's current R & D efforts and proposed future activities.

Surprisingly, as shown below in Table B.5, relatively simple methodologies are used to select R & D projects. This is despite the sophisticated methodologies available and the large amounts of funds expended on urban transit R & D projects.

B.6 VALUE OF PROJECTS DESCRIBED IN THE R & D PROJECT INVENTORY (SECTION A)

Due to the number of evaluation criteria (8), the number of respondents (16), and the number of R & D projects included in the project inventory (276), the volume of data resulting from this part of the value analysis questionnaire was substantial. Consequently, the following data represents a summary of the key variables only. For evaluations of individual projects, please refer to the following appendices.

APPENDIX B.1 - a project by project listing of the average scores for all eight evaluation criteria and the overall project average score. Separate groupings are provided for all transit operator respondents, all government agency respondents, and transit operator/government agency respondents combined.

APPENDIX B.2 - a project by project listing of the average scores and two measures of variance namely standard deviation and "z" scores. Separate groupings are provided for all transit operator respondents, all government agency respondents and all transit operator/government respondents combined.

APPENDIX B.3 AND B.4 - a project by project listing of the ranking of each project within its specific subject category (Appendix B.2) and compared to all projects (Appendix B.3). Separate groupings are provided for all transit operator respondents, all government agency respondents, and for all transit system/government agency respondents combined.

TABLE B.3

RESPONDENTS EVALUATION OF OWN ORGANIZATIONS R & D EFFORTS

	AVERAGE SCORE		
EVALUATION CRITERIA	TRANSIT SYSTEMS	GOVERNMENT AGENCIES	COMBINED
Benefit Potential/ Payback on Investment	4.7	5.0	4.8
Scientific Potential	3.0	3.0	3.0
Technical Merit	3.3	3.8	3.5
Utility	4.1	4.6	4.3
Transferability	3.0	4.2	3.5
Originality/ Scope of Interest	3.6	3.0	3.7
Urgency	3.9	4.2	4.0
ALL CRITERIA	3.7	4.1	3.8

TABLE B.4

OBSTACLES AND SOLUTIONS TO MORE EFFECTIVE R & D

FREQUENCY OF RESPONSE	OBSTACLE
6	Lack of sufficient R & D funds.
6	Lack of time/not enough staff/lack of qualified staff.
2	Lack of R & D information/lack of up-to-date data.
2	No clear national policy and mandate/no clear R & D objectives.
1	R & D projects too expensive.
1	Inconsistent funding.
1	Lack of lab facilities.
1	Lack of cooperation among R & D partners.
1	Lack of knowledge at Provincial level of current problems facing transit operators.
1	Lack of R & D coordination.

FREQUENCY OF RESPONSE	PROPOSED SOLUTION
4	Increased funding from senior levels of government.
3	Coordination mechanism for selecting, funding, and implementing R & D projects.
1	Shared R & D efforts with other levels of government/private industry.
1	Federal policy and program for urban transit R & D.
1	Subsidies for R & D projects should include in-house costs.
1	Increased recognition of value of R & D by senior management.
1	No practical solutions without increased staff to stay abreast of problems.

TABLE B.5

METHOD USED TO SELECT R & D PROJECTS

FREQUENCY OF RESPONSE	METHOD USED
12	Staff Discussions
9	Cost/Benefit Analysis
4	Standard Budgeting Techniques
3	No formal Process of Evaluation
2	Scoring/Scaling Methods
0	Simulation Analysis
0	Decision Theory/Decision
0	Tree Diagramming
0	Mathematical Optimization Methods (Linear and Dynamic Programming)

TABLE B.6

DISTRIBUTION OF SCORES BY AGENCY

AVERAGE SCORE	TRANSIT OPERATORS	GOVERNMENT AGENCIES	COMBINED
Less than 1.00	3 (1.09%)	1 (0.36%)	0 (0.00%)
1.01 - 1.25	5 (1.81%)	3 (1.09%)	2 (0.72%)
1.26 - 1.50	8 (2.90%)	10 (3.62%)	13 (4.71%)
1.51 - 1.75	33 (11.96%)	16 (5.80%)	16 (5.80%)
1.76 - 2.00	36 (13.04%)	11 (3.99%)	35 (12.68%)
2.01 - 2.25	50 (18.12%)	27 (9.78%)	40 (14.49%)
2.26 - 2.50	51 (18.48%)	45 (16.30%)	59 (21.38%)
2.51 - 2.75	40 (14.49%)	48 (17.39%)	53 (19.20%)
2.76 - 3.00	22 (7.97%)	45 (16.30%)	30 (10.87%)
3.01 - 3.25	15 (5.43%)	36 (13.04%)	15 (5.43%)
3.26 - 3.50	8 (2.90%)	23 (8.33%)	7 (2.54%)
3.51 - 3.75	4 (1.45%)	8 (2.90%)	5 (1.81%)
3.76 - 4.00	1 (0.36%)	1 (0.36%)	1 (0.30%)
Greater than 4.00	0 (0.00%)	2 (0.72%)	0 (0.00%)
TOTAL	276	276	276

% OF SCORES> 3.25	4.71	12.32	4.71
% OF SCORES> 2.50	32.61	59.10	40.21
% OF SCORES> 1.75	82.24	89.13	88.77
% OF SCORES> 1.75	17.76	10.87	11.23

B.6.1 Summary of Value Analysis by Benefit Criteria

As shown in Figure B.1 on average, projects were rated highest by transit operators in terms of the benefit potential and utility criteria. This indicates that the R & D projects completed and/or underway in 1983-84 will have a high return in terms of increased productivity, cost effectiveness, etc., and will contribute towards more valuable administrative/operational/policy decisions. The lowest average scores for the individual evaluation criteria are for urgency, originality/scope of interest, and scientific potential. The low average scores for urgency may indicate that R & D products are being developed with sufficient lead time and/or that the R & D activities are not addressing urgent industry needs/priorities. The low average score for originality/scope of interest indicates what has already been confirmed by the development of the project inventory i.e. that many of the projects are not unique, there is duplication, and that many projects are conducted without consideration for regional/national interests. The low score for scientific potential is not particularly surprising since very few urban transit R & D projects are undertaken purely in the interests of advancing scientific knowledge.

The average scores by benefit criteria for the government agency respondents are much the same as described above with one exception. On average, the government agency responses are 13.5% higher than the average scores for all transit operators. In other words, government agencies were generally more optimistic when evaluating R & D projects. This can be partially attributed to the difference in the sample size (11 transit operators versus 5 government agencies).

The optimism of the government agency respondents is shown more clearly in Table B.6. Transit operators gave only 4.71% of all projects an average score of greater than 3.25, compared to 12.32% of all projects evaluated by government agencies. As expected, the majority of the scores are concentrated around the mid-part of the range (i.e. 2.50), however, 59.1% of all government agency scores are above 2.50 compared to only 32.61% of the projects evaluated by transit operators.

Overall, there is over 50% difference between the highest average score for an individual evaluation criteria and the lowest (2.90 versus 1.90).

B.6.2 Summary of Value Analysis by Subject Area

As summarized in Figure B.2, there are large differences between how transit operators and government agencies view the value of current industry R & D efforts in various subject categories.

Both government agency and transit operator respondents ranked the projects in General Transportation Research as having the highest value, however, this category includes only two projects. For the remaining subject categories, there is sharp disagreement concerning the relative value of the projects. Transit operators gave the Training/Labour Relations projects an average score of 2.75 or 20% higher than the average score for all projects. This resulted in

FIGURE B.1

SUMMARY OF VALUE ANALYSIS BY BENEFIT CRITERIA

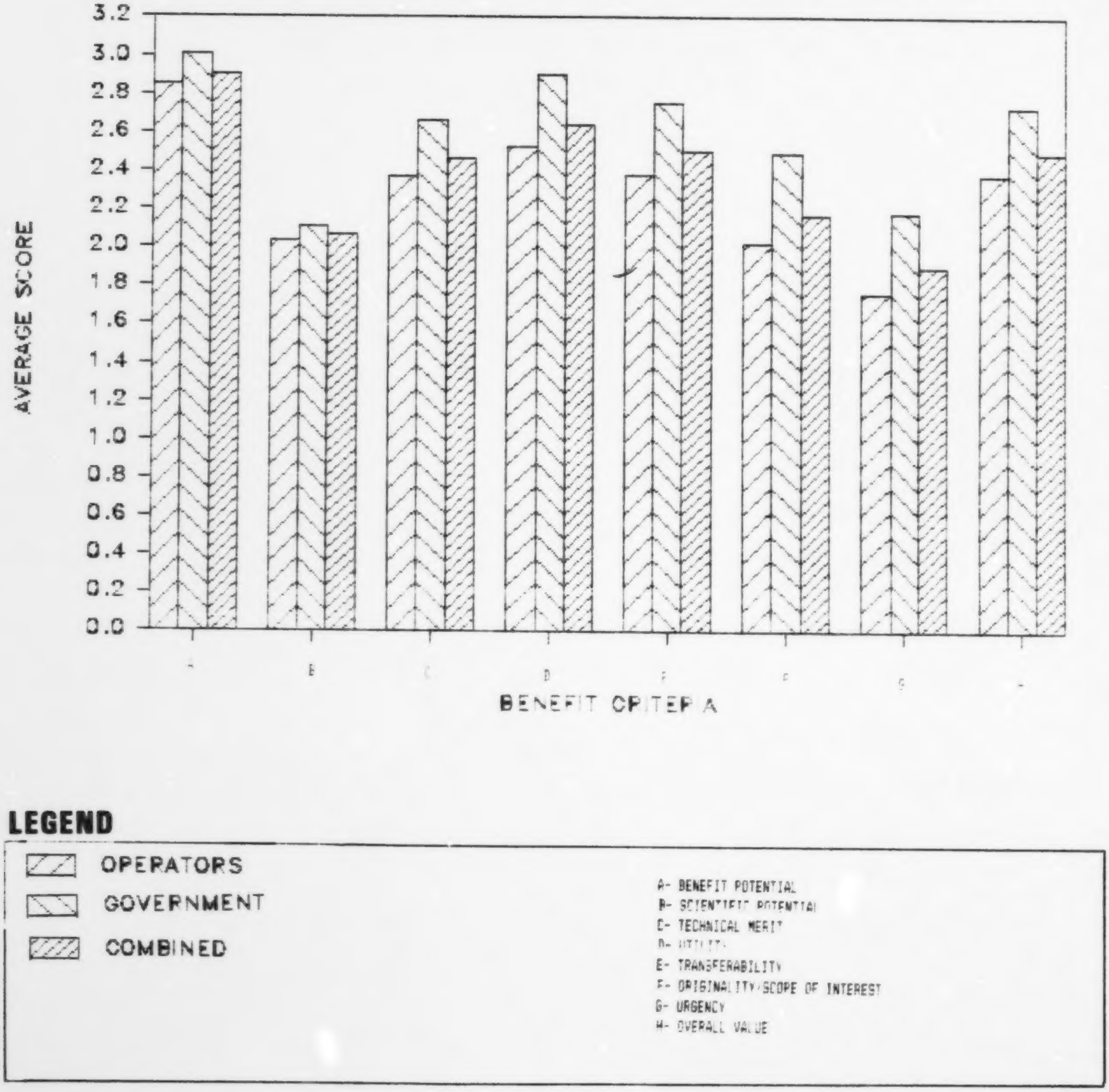
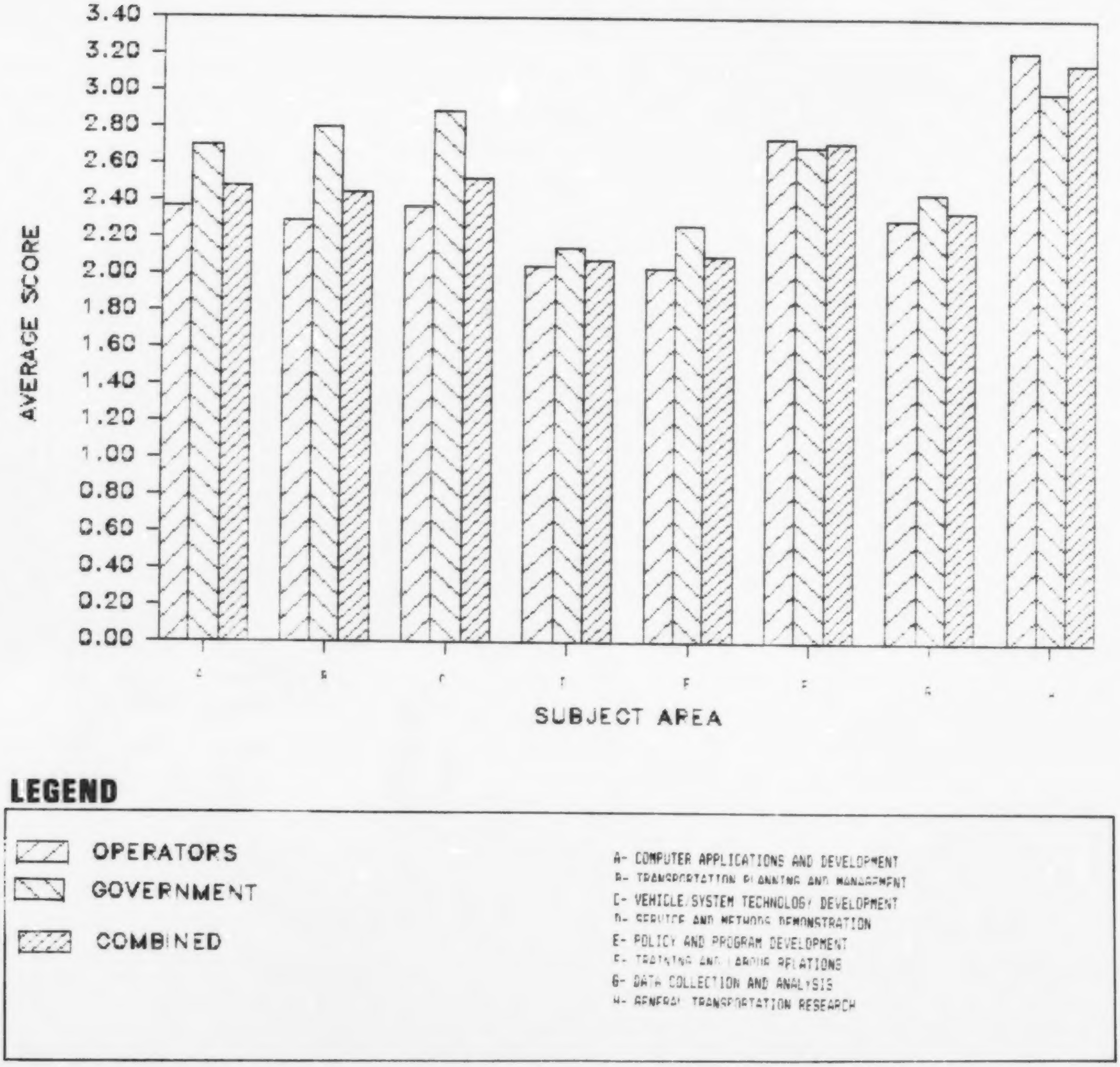


FIGURE B.2

SUMMARY OF VALUE ANALYSIS BY SUBJECT AREA



Training/Labour Relations being the second highest ranked subject category according to the transit operators. Government agency respondents on the other hand gave the Training/Labour Relations projects an average score of 2.70 (or only 4% higher than the average for all projects) making this category the fifth highest ranked subject category according to government agencies. Other differences include the service and methods demonstration subject category. Government agency representatives gave these projects the third highest ranking compared to the sixth highest ranking accorded by transit operator respondents. All other subject categories were roughly equal in ranking although again the government agency average scores are consistently higher by 12-15% overall.

Using the combined transit operator/government agency average scores, the General Transportation Research subject category ranks highest followed by Training and Labour Relations, Computer Applications and Development, Vehicle/System Technology Development, Service and Methods Demonstration, Data Collection and Analysis, Policy and Program Development, and lastly Transportation Planning and Management. The low average scores for the latter three subject categories is partially due to the local nature of these types of projects, as well as the fact that many of the projects in these categories are operational type projects with little scientific potential, transferability, or technical merit to other jurisdictions.

The distribution of scores for transit operator/government agency respondents combined is shown in Table B.7. This clearly shows the differences in the distribution of scores for the major subject categories. The Data Collection and Analysis, Transportation Planning and Management, and Policy and Program Development subject categories have very few projects with scores greater than 2.50 (26.67%, 15.79%, and 6.25% respectively) especially in comparison to Service and Methods Demonstration (53.33%) and Vehicle/System Technology Development (53.41%).

The Computer Applications and Development category has the highest percentage of projects with scores greater than 3.25 (14.75%). In fact, when examining the highest ranked individual projects (See Table B.8), 6 of the top 10 and 11 of the top 27 projects are in the Computer Applications and Development subject category. Of the 11 computer related projects outlined in Table B.8, 8 are in the Comprehensive Vehicle Monitoring Systems sub-category. It is interesting to note that 5 CUTA initiated projects are in the top 10% of all individually ranked projects namely project numbers 131 (6th highest ranked project), 260 (15th), 255 (15th), 256 (19th), and 5 (26th).

B.6.3 Degree of Consensus with Specified Statements

As mentioned in Section B.2 - Methodology, respondents were also asked to indicate their level of agreement or disagreement with a number of specified statements. The results of this part of the value analysis questionnaire are outlined in Table B.9 and described below:

Level of R & D

There is strong consensus that the level of urban transit R & D is unsatisfactory, that urban transit R & D funding should be increased to meet current industry needs and that current funding policies for the conduct of R & D are not generous enough. This corresponds with the responses to the initial questions concerning obstacles to more effective R & D.

TABLE B.7

DISTRIBUTION OF SCORES BY SUBJECT CATEGORY

AVERAGE SCORE	NUMBER OF PROJECTS							
	VEHICLE/SYSTEM TECHNOLOGY DEVELOPMENT	SERVICE AND METHODS DEMONSTRATION	COMPUTER APPLICATIONS AND DEVELOPMENT	TRANSPORTATION PLANNING AND MANAGEMENT	POLICY AND PROGRAM DEVELOPMENT	TRAINING AND LABOUR RELATIONS	DATA COLLECTION AND ANALYSIS	GENERAL TRANSPORTATION RESEARCH
Less than 1.00	0	0	0	0	0	0	0	0
1.01 - 1.25	1	0	0	1	0	0	0	0
1.26 - 1.50	2	2	2	6	1	0	0	0
1.51 - 1.75	2	2	2	9	0	0	1	0
1.76 - 2.00	8	4	6	11	4	0	2	0
2.01 - 2.25	11	2	9	6	7	2	3	0
2.26 - 2.50	17	4	15	15	3	0	5	0
2.51 - 2.75	25	7	10	7	1	1	2	0
2.76 - 3.00	14	5	6	1	0	2	1	1
3.01 - 3.25	7	2	2	1	0	2	1	0
3.26 - 3.50	0	1	5	0	0	0	0	1
3.51 - 3.75	1	1	3	0	0	0	0	0
3.76 - 4.00	0	0	1	0	0	0	0	0
Greater than 4.00	0	0	0	0	0	0	0	0
TOTAL NUMBER OF PROJECTS	88	30	61	57	16	7	15	2
AVERAGE SCORE	2.48	2.45	2.53	2.08	2.11	2.73	2.35	3.16
% OF SCORES> 3.25	1.13	6.67	14.75	0.00	0.00	0.00	0.00	50.00
% OF SCORES> 2.50	53.41	53.33	44.26	15.79	6.25	71.43	26.67	50.00
% OF SCORES> 1.75	94.32	86.67	93.44	71.93	93.75	100.00	93.33	100.00
% OF SCORES> 1.75	5.68	13.33	6.56	28.07	6.25	0.00	6.66	0.00

TABLE B.8

HIGHEST RANKED PROJECTS (TOP 10% OF ALL PROJECTS)

OVERALL RANKING	PROJECT NUMBER	AVERAGE SCORE	MAJOR SUBJECT CATEGORY	MINOR SUBJECT CATEGORY	PROJECT NAME/TITLE OF REPORT
1	124	3.82	Computer Applications and Developments	Comprehensive Vehicle Monitoring Systems	Computerization of CTCRO's Operations
2	121	3.66	Computer Applications and Development	Comprehensive Vehicle Monitoring Systems	Transit Information Communication and Control System (TICCS)
3	50	3.59	Vehicle/System Technology Development	Alternative Energy Vehicles/ Alternative Fuels	Fuel Efficient City Bus
4	106	3.57	Service and Methods Demonstration	Fare Collection/ Fare Policy	Identification and Evaluation of Fare Collection Equipment with Dollar Bill Acceptance
5	128	3.53	Computer Applications and Development	Comprehensive Vehicle Monitoring Systems	Transit Data Unit
6	122	3.52	Computer Applications and Development	Comprehensive Vehicle Monitoring Systems	Automated Transit Vehicle Information System
7	131	3.50	Computer Applications and Development	Automatic Passenger Counting Systems	APC Uniform Functional Requirements Definition
8	113	3.48	Service and Methods Demonstration	Articulated Buses	Articulated Bus - An In-Service Evaluation
9	275	3.46	General Transportation Research	-	Urban Transit R & D Inventory
10	126	3.45	Computer Applications and Development	Comprehensive Vehicle Monitoring Systems	Kitchener Transit Communication and Information System
11	125	3.41	Computer Applications and Development	Comprehensive Vehicle Monitoring Systems	CIS - Phase VI

TABLE B.8 (CONT'D)

HIGHEST RANKED PROJECTS (TOP 10% OF ALL PROJECTS)

OVERALL RANKING	PROJECT NUMBER	AVERAGE SCORE	MAJOR SUBJECT CATEGORY	MINOR SUBJECT CATEGORY	PROJECT NAME/TITLE OF REPORT
11	129	3.41	Computer Applications and Development	Comprehensive Vehicle Monitoring Systems	Communications Operator/ Bus Assignment
13	123	3.36	Computer Applications and Development	Comprehensive Vehicle Monitoring Systems	Transinfo Project
14	6	3.23	Vehicle/System Technology Development	Paratransit/ Disabled Vehicles	Development of a Small Heavy Duty Accessible Transit Bus
15	214	3.21	Transportation Planning and Management	Transportation Planning Models	An Interactive Graphic Method for Road and Transit Planning
15	260	3.21	Data Collection and Analysis	General Statistics/ Performance Indicators	Uniform Transit Statistics
15	255	3.21	Training and Labour Relations	Management Training	Developing Market Requirements for Transit Management Training Program
18	32	3.19	Vehicle/System Technology Development	Alternative Energy Vehicles/ Alternative Fuels	Nickel Zinc Battery for Cold Starts
19	256	3.13	Training and Labour Relations	Management Training	Developing Systems Requirements for Transit Management Training Program
19	153	3.13	Computer Applications and Development	Scheduling/Runcutting/ Dispatching - Regular Transit	Enhancements to Hastus System
21	31	3.10	Vehicle/System Technology Development	Alternative Energy Vehicles/ Alternative Fuels	Lower Cost Nickel Zinc Batteries
22	11	3.09	Vehicles/System Technology Development	Vehicle Components and Engines	Experimental Engine and Transmission Project

TABLE B.8 (CONT'D)

HIGHEST RANKED PROJECTS (TOP 10% OF ALL PROJECTS)

OVERALL RANKING	PROJECT NUMBER	AVERAGE SCORE	MAJOR SUBJECT CATEGORY	MINOR SUBJECT CATEGORY	PROJECT NAME/TITLE OF REPORT
22	42	3.09	Vehicle/System Technology Development	Alternative Energy Vehicles/ Alternative Fuels	OC Transpo Propane Bus Demonstration Project
22	114	3.09	Service and Methods Demonstration	Articulated Buses	Use of Articulated Buses
25	173	3.06	Computer Applications and Development	General Computer Applications	Computers in the Transit Industry
26	5	3.05	Vehicle/System Technology Development	Paratransit/Disabled Transit Vehicles	Transit Vehicle for the Disabled - Specification Guidelines
27	94	3.05	Service and Methods Demonstration	Reserved Bus Lanes/ Transit Priorities	Rules of the Road Demonstration Project
28	56	3.02	Vehicle/System Technology Development	Alternative Energy Vehicles/ Alternative Fuels	High Energy Density Flywheel Rotor

FOOTNOTES

1 - The top 10% of all individually ranked projects also corresponds to all projects with an average score of greater than 3.00.

TABLE B.9

RESULTS OF NORMATIVE SURVEY OF VALUE ANALYSIS

STATEMENT	LEVEL OF AGREEMENT - TRANSIT OPERATORS						LEVEL OF AGREEMENT - GOVERNMENT AGENCIES						DEGREE OF CONSENSUS
	STRONGLY AGREE	SOMEWHAT AGREE	NEITHER AGREE/ DISAGREE	SOMEWHAT DISAGREE	STRONGLY DISAGREE	TOTAL	STRONGLY AGREE	SOMEWHAT AGREE	NEITHER AGREE/ DISAGREE	SOMEWHAT DISAGREE	STRONGLY DISAGREE	TOTAL	
Level of R & D													
The level of urban transit R & D is satisfactory to meet current industry needs.	0	1	4	4	1	10	0	0	2	3	0	5	8 of 15 (53%) disagree with this statement.
The level of urban transit R & D should be increased significantly to meet current industry needs.	1	4	3	0	0	8	1	4	0	0	0	5	10 of 13 (77%) agree with this statement.
Government funding policies for R & D projects are generous.	0	2	1	3	4	10	1	1	2	1	0	5	8 of 15 (53%) disagree with this statement.
Value of R & D by Subject Category													
Current R & D in the area of Vehicle/System Technology Development is valuable.	2	4	1	2	1	10	1	3	0	1	0	5	10 of 15 (67%) agree with this statement.
Current R & D in the area of Service and Methods Demonstrations is valuable.	3	4	0	3	0	10	2	2	1	0	0	5	11 of 15 (73%) agree with this statement.

TABLE B.9 (CONT'D)

RESULTS OF NORMATIVE SURVEY OF VALUE ANALYSIS

STATEMENT	LEVEL OF AGREEMENT - TRANSIT OPERATORS						LEVEL OF AGREEMENT - GOVERNMENT AGENCIES						DEGREE OF CONSENSUS
	STRONGLY AGREE	SOMEWHAT AGREE	NEITHER AGREE/ DISAGREE	SOMEWHAT DISAGREE	STRONGLY DISAGREE	TOTAL	STRONGLY AGREE	SOMEWHAT AGREE	NEITHER AGREE/ DISAGREE	SOMEWHAT DISAGREE	STRONGLY DISAGREE	TOTAL	
Value of R & D by Subject Category (Cont'd)													
Current R & D is in the area of Computer Applications and Development is valuable.	4	3	2	1	0	10	3	2	0	0	0	5	12 of 15 (80%) agree with this statement.
Current R & D in the area of Transportation Planning and Management is valuable.	2	2	4	2	0	10	2	2	0	1	0	5	8 of 15 (53%) agree with this statement.
Current R & D in the area of Policy and Program Development is valuable.	2	0	4	4	0	10	2	0	2	1	0	5	No Consensus.
Current R & D in the area of Training and Labour Relations is valuable.	2	2	2	2	2	10	1	3	0	0	1	5	8 of 15 (53%) agree with this statement.
Current R & D in the area of Data Collection and Analysis is valuable.	3	2	2	2	1	10	2	0	2	1	0	5	No Consensus.
Current R & D in the area of General Transportation Research is valuable.	2	2	3	2	1	10	0	4	0	0	1	5	8 of 15 (53%) agree with this statement.

TABLE B.9 (CONT'D)

RESULTS OF NORMATIVE SURVEY OF VALUE ANALYSIS

STATEMENT	LEVEL OF AGREEMENT - TRANSIT OPERATORS: STRONGLY AGREE	SOMEWHAT AGREE	NEITHER AGREE/ DISAGREE	SOMEWHAT DISAGREE	STRONGLY DISAGREE	TOTAL	LEVEL OF AGREEMENT - GOVERNMENT AGENCIES: STRONGLY AGREE	SOMEWHAT AGREE	NEITHER AGREE/ DISAGREE	SOMEWHAT DISAGREE	STRONGLY DISAGREE	TOTAL	DEGREE OF CONSENSUS
Value of R & D by Agency													
The current R & D efforts of transit operators are valuable.	3	4	1	2	0	10	0	1	3	1	0	5	8 of 15 (53%) agree with this statement.
The current R & D efforts of provincial governments are valuable.	2	2	2	3	1	10	1	2	2	0	0	5	No Consensus.
The current R & D efforts of the federal government are valuable.	2	0	1	5	2	10	0	4	1	0	0	5	No Consensus.
The current R & D efforts of universities and private research organizations are valuable.	2	1	3	4	0	10	0	3	1	1	0	5	No Consensus.
The current R & D efforts of manufacturers/suppliers are valuable.	2	3	2	2	1	10	0	5	0	0	0	5	10 of 15 (67%) agree with this statement.

TABLE B.9 (CONT'D)

RESULTS OF NORMATIVE SURVEY OF VALUE ANALYSIS

STATEMENT	LEVEL OF AGREEMENT - TRANSIT OPERATORS						LEVEL OF AGREEMENT - GOVERNMENT AGENCIES						DEGREE OF CONSENSUS
	STRONGLY AGREE	SOMEWHAT AGREE	NEITHER AGREE/ DISAGREE	SOMEWHAT DISAGREE	STRONGLY DISAGREE	TOTAL	STRONGLY AGREE	SOMEWHAT AGREE	NEITHER AGREE/ DISAGREE	SOMEWHAT DISAGREE	STRONGLY DISAGREE	TOTAL	
Benefits of R & D													
Current R & D will result in increased cost-effectiveness of transit operations.	3	6	0	1	0	10	1	4	0	0	0	5	14 of 15 (93%) agree with this statement.
Current R & D will result in higher quality manufactured goods.	2	5	3	0	0	10	0	3	2	0	0	5	10 of 15 (67%) agree with this statement.
Current R & D will result in increased levels of transit ridership.	1	3	4	2	0	10	0	2	2	1	0	5	No Consensus.
Current R & D will result in higher export sales for suppliers.	1	4	4	1	0	10	0	4	1	0	0	5	9 of 15 (60%) agree with this statement.
Current R & D will result in policy and administrative changes.	1	3	5	1	0	10	0	1	3	1	0	5	No Consensus.

TABLE B.9 (CONT'D)

RESULTS OF NORMATIVE SURVEY OF VALUE ANALYSIS

STATEMENT	LEVEL OF AGREEMENT - TRANSIT OPERATORS						LEVEL OF AGREEMENT - GOVERNMENT AGENCIES						DEGREE CONSENSUS
	STRONGLY AGREE	SOMEWHAT AGREE	NEITHER AGREE/ DISAGREE	SOMEWHAT DISAGREE	STRONGLY DISAGREE	TOTAL	STRONGLY AGREE	SOMEWHAT AGREE	NEITHER AGREE/ DISAGREE	SOMEWHAT DISAGREE	STRONGLY DISAGREE	TOTAL	
Methods for Increasing Value of R & D													
Urban transit R & D would be more valuable if the federal government were more involved in project identification and selection.	2	2	1	2	3	10	0	2	0	2	1	5	8 of 15 (53%) disagree with this statement.
Urban transit R & D would be more valuable if provincial governments were more involved in project identification and selection.	2	3	1	2	2	10	1	4	0	0	0	5	10 of 15 (67%) agree with this statement.
Urban transit R & D would be more valuable if transit operators were more involved in project identification and selection.	6	3	1	0	0	10	3	2	0	0	0	5	14 of 15 (93%) agree with this statement.
Urban transit R & D would be more valuable if CUTA were more involved in project identification and selection.	2	6	2	0	0	10	2	3	0	0	0	5	13 of 15 (87%) agree with this statement.

Value of R & D by Subject Category

The degree of consensus concerning whether or not the R & D in general subject categories is valuable is highest for Computer Applications and Development, Service and Methods Demonstration and Vehicle/System Technology Development, and lowest for Data Collection and Analysis and Policy and Program Development. This correspond fairly closely to the data presented previously in Figure 8.

Value of R & D by Agency

There is moderate consensus that the current R & D efforts of transit operators and manufacturers are valuable. However, the R & D efforts of provincial governments, the federal government and universities/private research organizations is in considerable doubt according to the respondents.

Benefits of R & D

Funding agencies will be satisfied by the high degree of consensus (14 of 15) for the statement that current R & D will result in increased cost-effectiveness of transit operations. As well, there is high degree of consensus that current R & D efforts will lead to higher quality manufactured goods and higher export sales for suppliers. However, there is little consensus concerning whether or not current transit industry R & D efforts will increase ridership or result in policy/administrative changes.

Methods for Increasing Value of R & D

Overall, there is a high degree of consensus that if transit operators and CUTA were more involved in project identification and selection, urban transit R & D would be more valuable. This is strong support for CUTA's recent efforts to identify industry R &D needs including the planned R & D workshops. Provincial government involvement is also seen to be desirable, however, less federal involvement in project identification and selection is seen to desireable, although the degree of consensus is not especially high (53%).

B.7 CONCLUSIONS

In conclusion, while the value of current R & D efforts is satisfactory, there is obviously room for improvement. The projects which were judged to be of lower value should be seriously examined by the funding agencies. As well, R & D in those subject areas which were judged to be of low value should be re-examined especially in terms of allocating R & D funds in these areas in the future.

APPENDIX B

LIST OF APPENDICES

B.1 - Average Scores for All Evaluation Criteria

B.2 - Measures of Variance

B.3 - Ranking of Projects by Subject Category

B.4 - Overall Ranking of Projects

APPENDIX B.1

AVERAGE SCORES FOR ALL EVALUATION CRITERIA

LEGEND

A - Benefit Potential/Payback on Investment

B - Scientific Potential

C - Technical Merit

D - Utility

E - Transferability

F - Originality/Scope of Interest

G - Urgency

H - Overall Value

APPENDIX B.1 - AVERAGE SCORES FOR ALL EVALUATION CRITERIA

R & D PROJECT NUMBER	AVERAGES - OPERATING MEMBERS									AVERAGES - GOVERNMENT AGENCIES									AVERAGES - OPERATING & GOVERNMENT AGENCIES COMBINED								
	A	B	C	D	E	F	G	H	TOTAL AVERAGE	A	B	C	D	E	F	G	H	TOTAL AVERAGE	A	B	C	D	E	F	G	H	TOTAL AVERAGE
1	4.27	1.36	2.09	3.18	3.91	2.00	1.64	3.36	2.73	3.80	1.80	3.00	4.20	3.80	2.00	2.60	3.80	3.13	4.13	1.50	2.38	3.50	3.88	2.00	1.94	3.50	2.85
2	2.27	2.91	2.18	2.00	2.64	2.09	1.09	2.09	2.16	3.80	3.40	3.40	3.40	3.00	3.40	2.60	3.80	3.35	2.75	3.06	2.56	2.44	2.75	2.50	1.56	2.63	2.53
3	2.09	1.27	1.64	1.82	1.91	1.18	0.91	1.55	1.55	3.60	2.60	3.00	3.40	2.60	3.00	2.00	3.40	2.95	2.56	1.69	2.06	2.31	2.13	1.75	1.25	2.13	1.98
4	3.73	1.91	2.45	3.00	3.73	2.18	2.55	3.00	2.82	4.40	2.20	3.00	3.40	3.40	2.60	3.40	4.00	3.30	3.94	2.00	2.63	3.13	3.63	2.31	2.81	3.31	2.97
5	3.73	1.73	2.73	3.00	3.73	2.36	2.91	3.36	2.94	4.40	2.20	3.00	3.40	3.40	2.60	3.40	4.00	3.30	3.94	1.88	2.81	3.13	3.63	2.44	3.06	3.56	3.05
6	3.73	2.55	3.27	2.82	3.45	2.55	2.91	3.55	3.10	4.20	2.20	3.40	3.80	4.00	3.40	3.00	4.00	3.50	3.88	2.44	3.31	3.13	3.63	2.81	2.94	3.69	3.23
7	3.18	2.18	3.00	2.82	3.00	2.09	2.45	2.82	2.69	4.20	2.60	3.20	3.60	3.60	3.80	3.20	3.60	3.48	3.50	2.31	3.06	3.06	3.19	2.63	2.69	3.06	2.94
8	1.73	1.00	1.18	1.55	1.55	1.09	1.00	1.55	1.33	1.80	0.80	1.00	1.20	2.60	1.00	1.40	1.20	1.38	1.75	0.94	1.13	1.44	1.88	1.06	1.13	1.44	1.34
9	1.73	1.36	2.09	1.55	1.55	1.36	0.91	1.55	1.51	3.00	2.60	2.60	2.60	2.20	2.60	2.80	3.20	2.70	2.13	1.75	2.25	1.88	1.75	1.75	1.50	2.06	1.88
10	1.91	1.73	2.00	1.82	2.00	1.64	1.27	1.45	1.73	2.00	1.60	2.60	2.00	2.40	2.00	1.80	2.00	2.05	1.94	1.69	2.19	1.88	2.13	1.75	1.44	1.63	1.83
11	3.91	2.27	3.18	2.82	3.36	2.55	2.73	3.73	3.07	3.80	2.40	3.20	3.40	3.40	2.40	2.80	3.80	3.15	3.88	2.31	3.19	3.00	3.38	2.50	2.75	3.75	3.09
12	2.82	1.64	2.09	2.27	2.82	1.82	1.18	2.36	2.13	2.20	1.40	2.20	2.20	2.00	2.00	2.00	2.20	2.03	2.63	1.56	2.13	2.25	2.56	1.88	1.44	2.31	2.09
13	3.18	1.64	2.45	2.82	3.55	2.27	1.64	2.82	2.55	3.40	2.80	3.00	3.40	3.20	3.00	2.60	2.60	3.00	3.25	2.00	2.63	3.00	3.44	2.50	1.94	2.75	2.69
14	3.18	1.82	2.64	2.82	3.55	2.27	1.82	2.64	2.59	3.00	2.80	3.00	3.40	3.20	2.20	2.20	2.20	2.75	3.13	2.13	2.75	3.00	3.44	2.25	1.94	2.50	2.64
15	3.18	2.18	3.18	3.36	4.09	2.36	2.00	3.00	2.92	3.40	2.40	2.60	3.00	2.80	2.20	2.20	2.60	2.65	3.25	2.25	3.00	3.25	3.69	2.31	2.06	2.88	2.84
16	1.55	0.91	1.18	1.18	1.82	1.27	1.09	1.18	1.27	1.80	1.00	1.60	1.40	1.60	0.80	1.00	1.40	1.33	1.63	0.94	1.31	1.25	1.75	1.13	1.06	1.25	1.29
17	3.55	3.09	3.55	3.00	3.00	2.64	2.27	3.00	3.01	3.40	2.60	3.40	3.80	2.20	2.80	2.40	3.00	2.95	3.50	2.94	3.50	3.25	2.75	2.69	2.31	3.00	2.99
18	2.64	2.73	3.00	2.27	2.82	1.91	1.64	2.45	2.43	3.40	2.60	3.60	3.40	2.40	2.80	2.40	3.40	3.00	2.88	2.69	3.19	2.63	2.69	2.19	1.88	2.75	2.61
19	2.55	2.45	2.91	2.18	2.55	1.82	1.73	2.00	2.50	3.60	3.20	4.00	3.00	3.00	2.80	2.80	3.20	3.20	2.88	2.69	3.25	2.44	2.69	2.13	2.06	2.38	2.73
20	2.55	2.64	3.09	2.00	2.36	1.64	1.36	2.00	2.43	3.60	2.80	4.00	3.60	3.40	2.80	3.20	3.60	3.38	2.88	2.69	3.38	2.50	2.69	2.00	1.94	2.50	2.74
21	2.18	2.27	2.36	1.64	2.09	1.27	1.18	2.00	2.06	3.00	2.80	3.60	3.60	3.00	2.80	3.00	3.20	3.13	2.44	2.44	2.75	2.25	2.38	1.75	1.75	2.38	2.42
22	2.09	2.64	2.73	1.45	2.36	1.45	1.09	1.91	2.16	2.40	2.40	2.80	2.80	2.00	2.00	2.00	2.00	2.30	2.19	2.56	2.75	1.88	2.25	1.63	1.38	1.94	2.21
23	2.73	2.09	2.45	2.09	2.73	1.64	1.64	2.18	2.68	1.80	1.80	2.60	2.60	2.00	1.60	1.60	1.80	1.98	2.44	2.00	2.50	2.25	2.50	1.63	1.63	2.06	2.43
24	2.91	3.64	3.09	2.82	2.91	2.36	2.18	2.91	3.14	2.80	2.40	3.60	2.00	1.40	2.40	1.40	2.20	2.28	2.88	3.25	3.25	2.56	2.44	2.38	1.94	2.69	2.85
25	2.73	3.45	2.91	2.64	2.73	2.36	2.18	2.73	2.99	2.80	2.40	3.60	2.00	1.40	2.40	1.40	2.00	2.25	2.75	3.13	3.13	2.44	2.31	2.38	1.94	2.50	2.74
26	2.64	3.36	3.00	2.55	2.36	2.27	2.09	2.55	2.60	2.20	2.20	2.60	1.80	1.40	2.20	1.40	2.00	1.98	2.50	3.00	2.88	2.31	2.06	2.25	1.88	2.38	2.41
27	2.82	3.73	3.18	2.73	2.55	2.27	2.27	2.82	2.80	3.60	3.00	3.40	2.40	2.00	3.00	1.80	2.40	2.70	3.06	3.50	3.25	2.63	2.38	2.50	2.13	2.69	2.77
28	2.64	3.36	2.82	2.73	2.64	2.27	2.00	2.64	2.64	2.80	2.80	3.20	2.00	1.60	2.80	1.40	2.20	2.35	2.69	3.19	2.94	2.50	2.31	2.44	1.81	2.50	2.55
29	3.00	3.09	2.55	2.55	2.45	2.27	1.82	2.64	2.55	3.20	2.00	2.40	2.80	2.40	2.40	2.00	3.00	2.53	3.06	2.75	2.50	2.63	2.44	2.31	1.88	2.75	2.54
30	2.55	3.45	2.73	2.64	2.27	2.18	2.00	2.45	2.79	2.20	2.20	3.00	1.40	1.40	2.20	1.40	2.00	1.98	2.44	3.06	2.81	2.25	2.00	2.19	1.81	2.31	2.52
31	3.09	3.27	2.91	2.82	2.82	2.55	1.82	2.91	3.05	4.00	3.20	4.00	3.20	3.20	2.80	2.00	3.20	3.20	3.38	3.25	3.25	2.94	2.94	2.63	1.88	3.00	3.10
32	3.09	3.27	2.91	3.00	2.82	2.91	2.18	2.64	3.14	4.00	3.20	3.60	3.60	3.20	3.20	2.40	3.20	3.30	3.38	3.25	3.13	3.19	2.94	3.00	2.25	2.81	3.19
33	2.73	3.09	2.73	2.45	2.27	2.36	1.82	2.27	2.71	3.60	3.60	4.00	2.80	2.40	3.20	2.40	3.40	3.18	3.00	3.25	3.13	2.56	2.31	2.63	2.00	2.63	2.87
34	2.36	3.09	2.55	2.45	2.18	2.36	1.82	2.09	2.60	3.60	3.60	3.60	3.20	3.20	2.80	2.60	3.20	3.23	2.75	3.25	2.88	2.69	2.50	2.50	2.06	2.44	2.81
35	2.36	2.91	2.36	2.27	2.18	2.36	1.82	2.09	2.53	4.00	3.60	3.60	3.60	2.40	2.80	2.60	3.60	3.28	2.88	3.13	2.75	2.69	2.25	2.50	2.06	2.56	2.78
36	2.36	2.91	2.36	2.27	2.09	2.36	1.82	2.09	2.51	3.00	3.00	3.00	2.60	1.80	2.60	2.60	2.80	2.68	2.56	2.94	2.56	2.38	2.00	2.44	2.06	2.31	2.57
37	2.36	2.91	2.36	2.27	2.09	2.36	1.82	2.09	2.51	3.60	3.60	3.60	3.20	2.00	3.20	2.60	3.40	3.15	2.75	3.13	2.75	2.56	2.06	2.63	2.06	2.50	2.73
38	2.36	2.91	2.36	2.27	2.09	2.36	1.82	2.09	2.51	2.20	3.00	3.00	2.40	1.80	2.40	1.60	2.40	2.94	2.31	2.94	2.56	2.31	2.00	2.38	1.75	2.19	2.63
39	2.27	2.91	2.36	2.18	2.00	2.27	1.73	2.00	2.44	2.20	3.00	3.00	2.40	1.80	2.40	1.60	2.40	2.94	2.25	2.94	2.56	2.25	1.94	2.31	1.69	2.13	2.58
40	3.00	1.73	1.91	2.27	2.82	1.55	1.36	2.45	2.14	3.40	1.80	2.20	3.00	3.00	1.40	1.40	2.20	2.30	3.13	1.75	2.00	2.50	2.88	1.50	1.38	2.38	2.19
41	3.73	2.82	3.00	3.00	3.55	1.91	1.91	3.00	2.86	2.80	2.40	2.80	2.80	2.80	2.20	1.60	2.40	3.09	3.44	2.69	2.94	2.94	3.31	2.00	1.81	2.81	2.93
42	4.09	2.82	3.18	3.00	3.73	2.27	2.09	3.55	3.09	3.60	2.40	2.80	3.60	3.60	3.00	2.20	3.60	3.10	3.94	2.69	3.06	3.19	3.69	2.50	2.13	3.56	3.09
43	3.36	2.82	3.00	2.27	3.18	2.09	1.64	2.73	2.64	3.00	2.60	2.60	3.00	2.80	2.80	2.00	3.00	2.73	3.25	2.75	2.88	2.50	3.06	2.31	1.75	2.81	2.66
44	2.82	1.64	2.09	2.64	3.18	2.09	1.91	2.45	2.35	3.40	1.40	2.20	3.00	3.80	2.60	2.20	2.80	2.68	3.00	1.56	2.13	2.75	3.38	2.25	2.00	2.56	2.45
45	1.64	1.45	1.82	1.55	2.18	1.27	1.09	1.64	1.74	1.80	0.80	1.20	1.80	2.60	1.60	0.80	2.00	1.58	1.69	1.25	1.63	1.63	2.31	1.38	1.00	1.75	1.68
46	2.00	1.73	2.00	1.55	2.00	1.45	1.09	1.82	1.88	2.80	2.00	2.40	2.40	3.20	2.80	1.00	2.40	2.38	2.25	1.81	2.13	1.81	2.38	1.88	1.06	2.00	2.04
47	3.09	2.55	2.91	2.91	3.09	2.36	2.18	2.91	3.03	3.00	2.80	2.80	2.80	3.40	2.80	1.40	2.80	2.73	3.06	2.63	2.88	2.88	3.19	2.50	1.94	2.88	2.93
48	2.73	2.18	2.36	2.36	2.55	1.82	1.64	2.55	2.50	2.60	1.80	2.40	2.20	2.80	2.40	1.00	2.20	2.18	2.69	2.06	2.38	2.31	2.63	2.00	1.44	2.44	2.39
49	2.73	2.36	2.73	2.55	2.73	2.36	1.82	2.73	2.75	3.00	2.20	2.20	2.60	2.60	2.00	1.20	2.20	2.25	2.81	2.31	2.56	2.56	2.69	2.25	1.63	2.56	2.58
50	4.27	3.55	4.09	4.27	3.73	3.55	3.00	3.73	3.77	4.00	2.80	2.80	3.60	3.60	3.20	2.40	3.00	3.18	4.19	3.31	3.69	4.06	3.69	3.44	2.81	3.50	3.59
51	2.64	3.00	2.82	2.82	2.45	2.09	1.82	2.45	2.51	3.40	3.20	3.20	3.20	3.20	3.60	2.00	3.20	3.13	2.88	3.06	2.94	2.94	2.69	2.56	1.88	2.69	2.70
52	2.27	2.82	2.45	2.45	2.27	2.27	1.91	2.45	2.36	3.80	3.20	3.60	3.00	3.40	3.00	2.00	3.00	3.13	2.75	2.94	2.81	2.63	2.63	2.50	1.94	2.63	2.60
53	2.91	2.55	2.73	2.91	2.91	2.18	1.64	2.91	2.85	3.40	3.20	3.20	3.00	3.40	3.00	2.00	3.00	3.03	3.06	2.75	2.88	2.94	3.06	2.44	1.75	2.94	2.91
54	1.18	2.09	1.91	1.45	1.09	1.36	0.91	1.18	1.71	3.00	3.20	3.20	2.60	3.00	3.00	2.00	2.60	2.83	1.75	2.44	2.31	1.81	1.69	1.88	1.25	1.63	2.11
55	3.00	2.27	3.00	2.82	2.45	2.09	1.91	2.64	2.52	3.60	2.40	2.80	3.60	3.60	2.60	2.00	2.80	2.93	3.19	2.31	2.94	3.06	2.81	2.25	1.94	2.69	2.65

APPENDIX B.1 - (CONT'D)

R & D PROJECT NUMBER	AVERAGES - OPERATING MEMBERS									AVERAGES - GOVERNMENT AGENCIES									AVERAGES - OPERATING & GOVERNMENT AGENCIES COMBINED								
	A	B	C	D	E	F	G	H	TOTAL AVERAGE	A	B	C	D	E	F	G	H	TOTAL AVERAGE	A	B	C	D	E	F	G	H	TOTAL AVERAGE
56	3.36	3.73	3.36	3.00	2.64	2.82	2.36	3.00	3.03	3.40	2.80	3.60	3.00	3.00	3.00	2.20	3.00	3.00	3.38	3.44	3.44	3.00	2.75	2.88	2.31	3.00	3.02
57	2.36	3.09	2.55	2.36	2.55	1.91	1.55	1.91	2.51	2.40	2.20	2.20	2.40	2.80	2.20	2.00	2.40	2.33	2.38	2.81	2.44	2.38	2.63	2.00	1.69	2.06	2.45
58	2.55	3.09	2.55	2.36	2.36	1.73	1.55	2.00	2.50	2.40	2.20	2.20	2.40	2.80	2.20	2.00	2.40	2.33	2.50	2.81	2.44	2.38	2.50	1.88	1.69	2.13	2.44
59	2.36	2.00	2.00	2.00	2.00	1.36	1.36	1.73	2.04	3.00	3.00	3.20	3.00	3.00	3.00	2.40	3.00	2.95	2.56	2.31	2.38	2.31	2.31	1.88	1.69	2.13	2.34
60	2.91	2.55	3.09	2.91	2.36	2.27	1.91	2.55	2.83	3.40	2.60	2.80	3.00	3.40	3.00	2.40	3.00	2.95	3.06	2.56	3.00	2.94	2.69	2.50	2.06	2.69	2.87
61	2.91	2.91	3.09	2.55	2.36	2.09	1.55	2.45	2.74	2.60	3.60	3.20	2.20	2.80	2.60	1.60	2.20	2.60	2.81	3.13	3.13	2.44	2.50	2.25	1.56	2.38	2.69
62	2.82	1.91	2.45	2.45	2.45	1.64	1.27	2.27	2.16	2.60	1.20	2.40	3.40	3.20	3.00	2.00	3.00	2.60	2.75	1.69	2.44	2.75	2.69	2.06	1.50	2.50	2.30
63	2.18	1.27	2.00	1.82	1.36	0.91	0.91	1.45	1.64	2.00	1.00	1.40	2.40	1.80	1.60	1.80	2.00	1.75	2.13	1.19	1.81	2.00	1.50	1.13	1.19	1.63	1.68
64	2.73	1.64	2.36	2.55	2.36	1.73	1.18	2.18	2.30	3.40	1.60	2.40	3.40	2.60	2.60	2.00	3.00	2.63	2.94	1.63	2.38	2.81	2.44	2.00	1.44	2.44	2.41
65	1.36	0.55	0.82	1.18	0.91	0.45	0.45	0.73	0.89	1.60	1.00	0.80	1.60	1.20	1.60	1.80	1.60	1.40	1.44	0.69	0.81	1.31	1.00	0.81	0.88	1.00	1.06
66	2.09	1.18	1.82	1.55	1.55	1.09	0.91	1.45	1.60	3.00	2.20	3.00	2.40	2.60	2.20	1.80	2.20	2.43	2.38	1.50	2.19	1.81	1.88	1.44	1.19	1.69	1.88
67	2.36	1.36	2.00	2.00	1.64	1.18	1.18	1.64	1.84	3.40	1.80	3.00	2.00	2.20	2.20	1.40	2.20	2.28	2.69	1.50	2.31	2.00	1.81	1.50	1.25	1.81	1.98
68	2.36	1.09	1.82	2.18	1.91	1.55	1.55	1.82	1.96	3.00	2.20	3.00	2.40	2.20	2.20	2.00	2.20	2.40	2.56	1.44	2.19	2.25	2.00	1.75	1.69	1.94	2.11
69	2.73	2.91	2.73	1.82	1.64	2.36	0.82	2.00	2.34	3.40	3.20	3.60	2.80	2.40	3.60	2.40	3.40	3.10	2.94	3.00	3.00	2.13	1.88	2.75	1.31	2.44	2.59
70	1.64	1.73	2.09	1.45	1.09	1.64	1.09	1.55	1.53	2.60	1.60	2.40	2.40	2.80	3.60	1.60	2.60	2.45	1.94	1.69	2.19	1.75	1.63	2.25	1.25	1.88	1.82
71	2.45	2.64	2.82	1.73	1.73	1.73	1.45	1.91	2.06	3.40	3.20	3.60	2.40	2.40	3.20	1.40	3.00	2.83	2.75	2.81	3.06	1.94	1.94	2.19	1.44	2.25	2.30
72	2.64	2.27	2.64	2.09	1.64	1.82	1.64	2.09	2.10	3.40	2.40	3.20	2.40	2.40	2.80	1.40	2.20	2.53	2.88	2.31	2.81	2.19	1.88	2.13	1.56	2.13	2.23
73	2.55	2.00	2.55	1.82	1.36	1.73	1.55	2.00	2.14	3.00	2.40	3.20	2.40	2.00	2.80	1.40	2.20	2.43	2.69	2.13	2.75	2.00	1.56	2.06	1.50	2.06	2.23
74	2.55	2.18	2.73	1.82	1.82	2.00	1.64	2.00	2.30	3.40	2.80	3.60	2.80	2.40	3.20	1.40	3.00	2.83	2.81	2.38	3.00	2.13	2.00	2.38	1.56	2.31	2.48
75	2.00	2.18	2.73	1.64	1.45	1.45	1.27	1.55	1.96	3.20	3.20	3.60	2.40	3.00	2.80	1.60	2.80	2.83	2.38	2.50	3.00	1.88	1.94	1.88	1.38	1.94	2.25
76	2.73	2.91	3.09	2.00	1.82	2.00	1.64	1.73	2.46	3.60	3.60	4.00	2.80	3.40	2.80	2.00	3.20	3.18	3.00	3.13	3.38	2.25	2.31	2.25	1.75	2.19	2.70
77	2.73	1.73	2.55	2.18	1.91	1.91	2.00	1.82	2.31	3.60	2.40	3.20	3.00	2.80	3.20	2.60	3.20	3.00	3.00	1.94	2.75	2.44	2.19	2.31	2.19	2.25	2.54
78	2.91	2.09	2.64	2.36	1.82	1.91	1.36	2.00	2.35	2.60	3.20	3.20	2.60	2.60	2.80	1.80	2.20	2.63	2.81	2.44	2.81	2.44	2.06	2.19	1.50	2.06	2.44
79	1.82	1.91	1.91	1.82	1.09	1.36	1.09	1.64	1.74	2.60	2.40	2.80	2.20	2.20	2.40	2.20	2.20	2.38	2.06	2.06	2.19	1.94	1.44	1.69	1.44	1.81	1.95
80	2.36	1.45	2.18	1.91	1.55	1.36	1.09	1.73	1.88	2.40	2.40	2.80	2.40	2.40	2.40	2.00	2.40	2.40	2.38	1.75	2.38	2.06	1.81	1.69	1.38	1.94	2.05
81	1.82	1.36	1.73	1.55	1.27	1.36	1.18	1.36	1.60	3.40	2.60	3.40	2.60	2.20	2.40	2.00	2.40	2.63	2.31	1.75	2.25	1.88	1.56	1.69	1.44	1.69	1.94
82	3.00	1.36	2.18	3.00	3.18	1.82	1.82	2.27	2.33	3.80	2.20	2.20	3.80	4.20	3.80	3.40	3.80	3.40	3.25	1.63	2.19	3.25	3.50	2.44	2.31	2.75	2.66
83	2.55	2.55	2.55	2.00	1.73	1.82	0.82	1.82	2.18	3.20	3.20	3.60	2.00	3.20	3.60	1.80	3.00	2.95	2.75	2.75	2.88	2.00	2.19	2.38	1.13	2.19	2.43
84	2.64	1.55	2.36	2.82	3.00	2.18	2.18	2.64	2.42	3.60	1.40	2.20	3.40	3.40	3.40	3.00	3.40	2.98	2.94	1.50	2.31	3.00	3.13	2.56	2.44	2.88	2.59
85	2.64	1.55	2.18	2.64	2.64	2.00	1.82	2.27	2.22	3.00	1.80	1.80	3.00	3.20	3.20	2.80	3.00	2.73	2.75	1.63	2.06	2.75	2.81	2.38	2.13	2.50	2.38
86	2.18	1.73	2.00	1.64	1.64	1.45	1.00	1.82	1.85	3.00	1.80	3.00	2.80	3.60	2.00	2.00	3.00	2.65	2.44	1.75	2.31	2.00	2.25	1.63	1.31	2.19	2.12
87	2.27	1.64	2.27	2.09	2.27	1.91	1.27	1.91	1.95	3.80	1.80	3.40	3.60	4.00	2.00	2.40	3.40	3.05	2.75	1.69	2.63	2.56	2.81	1.94	1.63	2.38	2.30
88	2.73	1.64	2.27	2.09	1.55	1.64	1.18	1.82	2.05	3.20	1.80	3.00	2.40	3.20	2.60	2.60	2.60	2.68	2.88	1.69	2.50	2.19	2.06	1.94	1.63	2.06	2.26
89	2.45	1.82	2.27	2.45	2.45	2.27	2.09	2.09	2.74	3.00	2.40	3.60	3.00	2.80	1.60	2.60	2.60	2.70	2.63	2.00	2.69	2.63	2.56	2.06	2.25	2.25	2.72
90	1.73	1.18	1.82	1.27	1.55	1.27	1.18	1.64	1.78	2.20	1.60	2.40	2.60	2.20	1.80	1.80	2.20	2.10	1.88	1.31	2.00	1.69	1.75	1.44	1.38	1.81	1.89
91	3.00	1.18	2.36	2.91	2.91	2.55	2.36	2.55	2.48	2.00	1.20	2.00	2.40	2.40	1.40	1.60	1.60	1.83	2.69	1.19	2.25	2.75	2.75	2.19	2.13	2.25	2.27
92	2.09	0.91	1.55	1.82	2.00	1.55	1.36	1.82	1.64	2.00	1.20	2.00	2.40	1.60	1.40	2.00	2.00	1.83	2.06	1.00	1.69	2.00	1.88	1.50	1.56	1.88	1.70
93	1.00	1.09	1.36	0.91	1.09	1.00	0.82	1.00	1.03	2.60	2.00	2.80	2.60	2.60	2.80	2.00	2.60	2.50	1.50	1.38	1.81	1.44	1.56	1.56	1.19	1.50	1.49
94	4.09	2.36	3.00	3.18	3.18	2.64	2.27	3.00	2.97	3.80	2.20	3.40	3.80	3.80	2.80	2.80	3.40	3.25	4.00	2.31	3.13	3.38	3.38	2.69	2.44	3.13	3.05
95	3.36	2.18	2.64	2.82	2.18	2.09	2.27	2.73	2.53	3.60	1.60	2.80	3.60	2.80	2.20	2.60	2.80	2.75	3.44	2.00	2.69	3.06	2.38	2.13	2.38	2.75	2.60
96	3.36	1.45	2.00	3.00	3.00	2.64	2.09	2.45	2.50	3.60	1.60	2.40	4.00	3.60	3.00	2.60	3.40	3.03	3.44	1.50	2.13	3.31	3.19	2.75	2.25	2.75	2.66
97	1.64	0.91	1.55	1.73	1.73	1.18	1.36	1.45	1.59	2.80	1.20	2.40	2.40	2.20	1.80	2.20	2.40	2.18	2.00	1.00	1.81	1.94	1.88	1.38	1.63	1.75	1.78
98	2.64	1.18	1.82	2.27	1.55	1.27	1.45	1.82	1.75	3.20	1.20	2.00	2.80	3.00	2.20	2.20	2.40	2.38	2.81	1.19	1.88	2.44	2.00	1.56	1.69	2.00	1.95
99	3.18	1.45	2.00	2.64	2.36	1.91	1.73	2.45	2.22	3.40	1.80	2.60	3.00	2.80	2.80	2.80	3.40	2.83	3.25	1.56	2.19	2.75	2.50	2.19	2.06	2.75	2.41
100	2.36	1.18	1.91	2.18	2.18	1.64	1.64	2.18	2.10	3.20	1.20	2.40	3.20	2.60	2.20	2.20	2.40	2.43	2.63	1.19	2.06	2.50	2.31	1.81	1.81	2.25	2.21
101	2.55	0.91	1.45	2.00	1.82	1.36	1.45	1.82	1.84	3.00	1.20	2.60	3.80	3.60	2.40	2.80	3.00	2.80	2.69	1.00	1.81	2.56	2.38	1.69	1.88	2.19	2.16
102	2.27	0.91	1.27	1.91	1.55	1.36	1.36	1.55	1.68	2.00	1.20	1.60	2.00	2.20	1.40	1.80	1.60	1.73	2.19	1.00	1.38	1.94	1.75	1.38	1.50	1.56	1.69
103	3.18	2.00	2.64	3.36	3.18	2.36	2.27	3.18	2.77	3.60	1.20	2.40	3.60	3.80	3.00	2.20	3.20	2.88	3.31	1.75	2.56	3.44	3.38	2.56	2.25	3.19	2.80
104	3.18	1.82	2.45	2.64	2.64	1.64	1.91	2.64	2.36	3.40	1.40	3.00	3.80	4.40	3.60	2.80	3.40	3.23	3.25	1.69	2.63	3.00	3.19	2.25	2.19	2.88	2.63
105	2.82	1.73	2.45	2.64	2.09	2.18	1.91	2.64	2.31	3.20	1.20	2.40	3.60	3.80	2.60	2.20	2.80	2.73	2.94	1.56	2.44	2.94	2.63	2.31	2.00	2.69	2.44
106	4.09	2.55	3.36	3.36	4.09	3.55	3.73	3.55	3.53	4.00	2.00	3.20	4.40	4.40	3.60	4.00	3.60	3.65	4.06	2.38	3.31	3.69	4.19	3.56	3.81	3.56	3.57
107	3.00	1.73	2.45	2.73	3.36	2.82	2.64	3.18	2.74	3.60	1.60	2.00	3.80	4.40	3.20	2.40	3.00	3.00	3.19	1.69	2.31	3.06	3.69	2.94	2.56	3.13	2.82
108	3.18	1.36	1.91	2.73	2.73	2.09	2.09	2.82	2.36	4.40	1.20	2.80	4.40	4.00	3.60	2.60	3.40	3.30	3.56	1.31	2.19	3.25	3.13	2.56	2.25	3.00	2.66
109	0.82	0.64	0.64	0.91	1.09	1.09	0.91	0.82	0.86	2.80	1.20	2.00	3.20	2.00	2.40	2.20	2.60	2.30	1.44	0.81	1.06	1.63	1.38	1.50	1.31	1.38	1.31
110	2.45	1.45	1.55	2.27	1.91	1.82	1.64	2.09	1.90	2.20	1.00	1.00	2.60	1.80	2.20	2.00	2.00	1.85	2.38	1.31	1.38	2.38	1.88	1.94	1.75	2.06	1.88

APPENDIX B.1 - (CONT'D)

R & D PROJECT NUMBER	AVERAGES - OPERATING MEMBERS									AVERAGES - GOVERNMENT AGENCIES									AVERAGES - OPERATING & GOVERNMENT AGENCIES COMBINED								
	A	B	C	D	E	F	G	H	TOTAL AVERAGE	A	B	C	D	E	F	G	H	TOTAL AVERAGE	A	B	C	D	E	F	G	H	TOTAL AVERAGE
111	3.00	2.18	2.36	2.82	2.64	2.36	1.82	2.82	2.50	3.20	1.40	2.40	3.20	3.00	2.60	2.80	3.00	2.70	3.06	1.94	2.38	2.94	2.75	2.44	2.13	2.88	2.56
112	3.18	2.36	2.64	2.82	2.45	2.45	1.91	3.00	2.60	3.60	2.40	3.60	4.40	3.60	2.80	3.20	3.60	3.40	3.31	2.38	2.94	3.31	2.81	2.56	2.31	3.19	2.85
113	4.27	2.45	3.55	3.73	3.73	3.00	2.82	3.73	3.41	4.00	2.40	3.60	4.80	4.00	3.60	3.20	3.60	3.65	4.19	2.44	3.56	4.06	3.81	3.19	2.94	3.69	3.48
114	3.55	2.09	2.82	3.00	3.00	2.45	2.45	3.00	2.80	4.40	2.40	3.60	4.80	4.00	3.60	3.20	4.00	3.75	3.81	2.19	3.06	3.56	3.31	2.81	2.69	3.31	3.09
115	2.55	1.27	2.09	2.36	2.18	1.73	2.09	2.18	2.26	4.00	2.20	3.40	4.40	3.60	2.80	3.20	3.40	3.38	3.00	1.56	2.50	3.00	2.63	2.06	2.44	2.56	2.63
116	3.36	1.82	2.82	2.64	2.45	1.64	1.91	2.64	2.41	4.00	2.40	3.60	4.40	4.00	3.60	3.20	3.60	3.60	3.56	2.00	3.06	3.19	2.94	2.25	2.31	2.94	2.78
117	3.36	1.82	2.82	3.00	3.09	2.09	2.36	2.82	2.67	3.60	2.40	3.60	4.40	4.00	3.60	2.80	3.60	3.50	3.44	2.00	3.06	3.44	3.38	2.56	2.50	3.06	2.93
118	2.64	1.27	2.27	2.36	2.82	2.09	1.82	2.27	2.19	2.80	2.20	2.60	3.60	3.60	2.80	2.40	3.00	2.88	2.69	1.56	2.38	2.75	3.06	2.31	2.00	2.50	2.41
119	2.91	1.18	1.91	1.82	2.82	1.45	1.91	2.09	2.21	3.40	1.40	2.60	3.40	3.20	1.80	2.40	2.40	2.58	3.06	1.25	2.13	2.31	2.94	1.56	2.06	2.19	2.33
120	3.36	1.82	2.36	2.45	2.91	1.91	2.09	2.55	2.43	3.40	1.40	3.00	3.40	3.20	1.80	2.40	2.80	2.68	3.38	1.69	2.56	2.75	3.00	1.88	2.19	2.63	2.51
121	4.27	3.55	3.82	3.27	3.27	2.91	3.00	3.91	3.50	4.60	3.60	4.40	4.40	4.00	3.20	3.60	4.40	4.03	4.38	3.56	4.00	3.63	3.50	3.00	3.19	4.06	3.66
122	4.09	3.18	4.00	3.64	3.36	3.09	2.82	3.73	3.49	3.60	3.60	3.60	4.00	3.60	3.60	3.00	3.60	3.58	3.94	3.31	3.88	3.75	3.44	3.25	2.88	3.69	3.52
123	3.82	3.00	3.82	3.45	2.91	2.73	2.64	3.36	3.22	4.40	3.40	3.80	4.00	3.40	3.40	3.00	4.00	3.68	4.00	3.13	3.81	3.63	3.06	2.94	2.75	3.56	3.36
124	3.73	3.09	3.73	3.73	2.82	3.00	2.91	3.45	3.64	4.80	3.40	4.20	4.80	4.20	3.80	3.40	4.80	4.18	4.06	3.19	3.88	4.06	3.25	3.25	3.06	3.88	3.82
125	3.82	3.36	4.00	3.45	2.36	3.27	3.18	3.55	3.38	4.40	3.40	3.40	3.60	3.40	3.00	3.00	3.60	3.48	4.00	3.38	3.81	3.50	2.69	3.19	3.13	3.56	3.41
126	3.91	3.00	3.91	3.27	2.55	3.09	3.00	3.55	3.28	4.80	3.00	4.20	4.40	3.80	3.40	3.40	3.60	3.83	4.19	3.00	4.00	3.63	2.94	3.19	3.13	3.56	3.45
127	3.18	1.91	2.82	2.55	2.00	2.64	2.27	2.64	2.50	3.80	2.20	2.60	3.80	3.40	3.00	3.00	3.00	3.10	3.38	2.00	2.75	2.94	2.44	2.75	2.50	2.75	2.69
128	3.55	2.91	3.36	3.00	3.18	3.18	2.91	3.27	3.49	4.40	3.60	4.00	4.40	3.20	2.60	3.00	3.60	3.60	3.81	3.13	3.56	3.44	3.19	3.00	2.94	3.38	3.53
129	3.91	3.09	3.27	3.45	3.09	3.45	2.91	3.36	3.32	4.40	3.40	4.20	4.40	3.00	2.40	3.00	4.00	3.60	4.06	3.19	3.56	3.75	3.06	3.13	2.94	3.56	3.41
130	2.64	2.45	2.55	2.36	2.55	1.91	1.09	1.82	2.39	2.80	2.00	2.80	2.40	2.00	2.20	2.20	2.40	2.35	2.69	2.31	2.63	2.38	2.38	2.00	1.44	2.50	2.38
131	3.82	2.82	3.45	4.18	4.18	3.45	3.00	3.73	3.58	4.00	2.20	3.00	4.00	4.00	3.00	2.80	3.60	3.33	3.88	2.63	3.31	4.13	4.13	3.31	2.94	3.69	3.50
132	2.91	1.73	2.00	2.55	2.91	1.82	1.73	2.18	2.23	2.60	2.40	2.00	2.60	2.60	2.00	2.00	2.20	2.30	2.81	1.94	2.00	2.56	2.81	1.88	1.81	2.19	2.25
133	3.27	2.09	2.55	3.09	3.09	2.36	1.73	2.36	2.57	2.60	2.40	2.00	2.60	2.60	2.00	2.00	2.20	2.30	3.06	2.19	2.38	2.94	2.94	2.25	1.81	2.31	2.48
134	3.45	2.36	2.82	2.91	2.64	2.18	1.27	2.55	2.52	3.40	2.40	3.60	3.40	3.00	2.80	2.40	3.00	3.00	3.44	2.38	3.06	3.06	2.75	2.38	1.63	2.69	2.67
135	3.09	2.64	3.09	2.73	2.36	2.36	1.73	2.82	2.60	3.40	2.40	3.20	3.40	2.60	2.80	2.40	3.00	2.90	3.19	2.56	3.13	2.94	2.44	2.50	1.94	2.88	2.70
136	2.64	1.64	1.82	2.18	2.36	1.73	1.09	1.82	1.91	3.40	2.60	3.40	3.80	3.40	3.00	2.40	3.40	3.18	2.88	1.94	2.31	2.69	2.69	2.13	1.50	2.31	2.30
137	2.82	1.82	2.55	2.55	2.82	2.00	1.64	2.18	2.30	3.60	2.60	3.40	4.00	4.00	3.40	2.40	3.60	3.38	3.06	2.06	2.81	3.00	3.19	2.44	1.88	2.63	2.63
138	2.09	1.45	2.09	1.82	1.82	1.09	1.00	1.55	1.78	3.00	2.60	2.60	2.60	2.20	2.40	2.20	2.60	2.53	2.38	1.81	2.25	2.06	1.94	1.50	1.38	1.88	2.03
139	2.09	1.55	2.09	1.64	1.91	1.82	1.18	1.91	1.95	2.60	1.20	2.40	2.60	2.60	1.60	2.20	2.60	2.78	2.25	1.44	2.19	1.94	2.13	1.75	1.50	2.13	2.19
140	2.55	1.64	2.18	1.91	1.73	2.00	1.18	2.55	1.97	2.20	1.60	2.40	2.60	2.60	1.60	2.20	2.60	2.78	2.44	1.63	2.25	2.13	2.00	1.88	1.50	2.56	2.18
141	2.36	1.18	1.55	2.00	2.27	1.27	1.00	1.64	1.66	3.00	2.40	2.80	2.40	2.40	2.20	2.20	2.80	2.53	2.56	1.56	1.94	2.13	2.31	1.56	1.38	2.00	1.93
142	2.18	1.64	2.00	2.18	1.82	1.73	1.45	1.82	1.85	3.60	3.20	3.60	3.20	2.80	2.80	2.60	3.60	3.18	2.63	2.13	2.50	2.50	2.13	2.06	1.81	2.38	2.27
143	2.91	2.36	2.55	2.36	1.73	2.00	1.73	2.18	2.23	3.20	3.20	3.20	2.80	2.40	2.20	2.60	3.20	2.85	3.00	2.63	2.75	2.50	1.94	2.06	2.00	2.50	2.42
144	3.45	2.91	2.91	2.82	1.82	2.36	1.73	3.09	2.64	4.20	3.40	4.20	3.00	3.00	2.60	2.40	3.40	3.28	3.69	3.06	3.31	2.88	2.19	2.44	1.94	3.19	2.84
145	2.73	1.45	1.82	2.45	1.18	1.64	1.55	1.73	1.82	3.60	3.20	3.60	3.00	2.60	2.60	2.40	2.80	2.98	3.00	2.00	2.38	2.63	1.63	1.94	1.81	2.06	2.18
146	2.18	1.18	1.64	2.00	1.18	1.64	1.55	1.45	1.60	2.80	2.80	3.20	3.00	3.00	3.00	2.20	2.80	2.85	2.38	1.69	2.13	2.31	1.75	2.06	1.75	1.88	1.99
147	2.55	1.55	1.82	2.64	1.36	1.64	1.55	1.64	1.84	3.60	2.80	3.60	3.60	3.00	2.20	2.00	3.20	3.00	2.88	1.94	2.38	2.94	1.88	1.81	1.69	2.13	2.20
148	2.55	2.36	2.73	2.27	1.82	2.00	1.45	2.36	2.19	2.60	3.40	3.40	2.60	2.20	2.60	2.20	2.60	2.70	2.56	2.69	2.94	2.38	1.94	2.19	1.69	2.44	2.35
149	1.18	0.91	1.00	1.18	0.82	1.00	0.91	0.91	1.21	2.20	2.20	3.00	1.80	2.20	1.80	1.80	1.80	2.10	1.50	1.31	1.63	1.38	1.25	1.25	1.19	1.19	1.53
150	2.45	2.00	2.27	1.73	2.09	1.82	1.27	1.82	2.13	2.40	2.80	3.20	1.60	2.40	2.00	1.40	2.00	2.23	2.44	2.25	2.56	1.69	2.19	1.88	1.31	1.88	2.16
151	1.82	1.36	2.09	1.55	1.73	1.45	1.18	1.45	1.74	2.00	2.60	3.40	1.80	2.60	1.80	1.40	1.80	2.18	1.88	1.75	2.50	1.63	2.00	1.56	1.25	1.56	1.88
152	3.18	1.91	2.36	2.45	2.00	1.91	1.82	2.27	2.24	3.40	2.20	2.60	2.20	3.00	2.20	1.40	2.20	2.40	3.25	2.00	2.44	2.38	2.31	2.00	1.69	2.25	2.29
153	4.00	3.09	3.18	3.36	3.36	2.18	2.27	3.18	3.08	3.60	2.60	3.40	3.40	3.60	3.40	2.60	3.40	3.25	3.88	2.94	3.25	3.38	3.44	2.56	2.38	3.25	3.13
154	3.45	2.09	2.55	2.82	2.09	1.64	1.82	2.36	2.35	3.60	2.60	3.40	3.40	3.20	3.00	2.60	3.40	3.15	3.50	2.25	2.81	3.00	2.44	2.06	2.06	2.69	2.60
155	2.91	2.27	2.73	2.55	2.09	2.00	1.82	2.55	2.36	3.00	2.00	2.80	2.80	3.00	2.40	2.40	2.80	2.65	2.94	2.19	2.75	2.63	2.38	2.13	2.00	2.63	2.45
156	3.64	2.45	3.18	3.09	3.18	2.00	2.18	3.09	2.85	3.60	2.60	3.40	3.00	3.20	3.00	2.60	3.40	3.10	3.63	2.50	3.25	3.06	3.19	2.31	2.31	3.19	2.93
157	3.64	2.73	3.00	2.55	2.73	2.09	2.18	2.91	2.73	4.00	3.20	3.60	3.80	3.40	3.20	3.00	3.60	3.48	3.75	2.88	3.19	2.94	2.94	2.44	2.44	3.13	2.96
158	2.09	1.82	2.09	1.36	2.18	1.45	1.18	2.00	2.17	3.20	2.20	3.00	3.00	2.80	2.60	2.60	3.00	2.80	2.44	1.94	2.38	1.88	2.38	1.81	1.63	2.31	2.39
159	1.91	1.36	1.64	1.73	1.55	1.27	1.18	1.55	1.52	3.00	1.60	2.00	2.40	1.80	1.60	2.00	2.00	2.05	2.25	1.44	1.75	1.94	1.63	1.38	1.44	1.69	1.69
160	3.18	2.45	2.73	2.45	2.09	2.36	1.55	2.27	2.63	3.20	3.20	3.60	2.00	2.20	2.80	2.00	3.20	2.78	3.19	2.69	3.00	2.31	2.13	2.50	1.69	2.56	2.68
161	3.09	2.36	2.45	2.36	2.73	2.45	1.45	2.36	2.41	3.60	3.00	3.40	2.60	3.00	2.20	2.20	3.00	2.88	3.25	2.56	2.75	2.44	2.81	2.38	1.69	2.56	2.55
162	3.64	2.91	2.45	2.91	3.27	2.64	2.00	2.73	2.82	3.60	3.20	3.60	3.60	2.80	3.00	2.80	3.60	3.28	3.63	3.00	2.81	3.13	3.13	2.75	2.25	3.00	2.96
163	2.91	2.00	2.27	2.55	2.55	2.36	1.73	2.18	2.32	3.60	2.80	3.20	3.60	3.20	3.40	2.40	3.60	3.23	3.13	2.25	2.56	2.88	2.75	2.69	1.94	2.63	2.60
164	1.91	1.18	1.55	1.55	1.82	1.82	1.55	1.55	1.61	3.40	1.80	3.00	3.40	2.00	2.40	2.40	3.40	2.73	2.38	1.38	2.00	2.13	1.88	2.00	1.81	2.13	1.96
165	2.91	2.55	2.82	2.73	3.27	2.64	2.18	2.55	2.70	3.40	1.20	1.60	3.00	2.40	2.00	2.20	2.60	2.30	3.06	2.13	2.44	2.81	3.00	2.44	2.19	2.56	2.38

APPENDIX B.1 - (CONT'D)

R & D PROJECT NUMBER	AVERAGES - OPERATING MEMBERS									AVERAGES - GOVERNMENT AGENCIES									AVERAGES - OPERATING & GOVERNMENT AGENCIES COMBINED								
	A	B	C	D	E	F	G	H	TOTAL AVERAGE	A	B	C	D	E	F	G	H	TOTAL AVERAGE	A	B	C	D	E	F	G	H	TOTAL AVERAGE
166	2.73	1.64	2.27	2.18	2.36	1.73	1.45	2.00	2.05	2.40	1.00	1.40	2.40	2.60	1.40	2.00	1.60	1.85	2.63	1.44	2.00	2.25	2.44	1.63	1.63	1.68	1.98
167	2.91	1.55	2.45	2.36	2.45	2.55	1.91	2.36	2.32	3.00	1.60	2.00	2.80	2.40	1.80	2.40	2.40	2.30	2.94	1.56	2.31	2.50	2.44	2.31	2.06	2.38	2.31
168	2.18	2.09	2.27	1.82	2.73	1.73	1.09	2.09	2.20	3.60	3.00	3.40	3.40	2.60	2.60	2.60	3.00	3.03	2.63	2.38	2.63	2.31	2.69	2.00	1.56	2.38	2.48
169	2.45	1.36	2.00	2.55	2.36	1.73	1.64	2.09	2.02	3.40	3.40	3.00	3.00	2.60	2.40	3.00	3.40	3.03	2.75	2.00	2.31	2.69	2.44	1.94	2.06	2.50	2.34
170	2.36	1.36	1.82	2.27	2.09	2.00	1.55	2.27	2.16	2.20	2.60	2.80	2.40	2.80	2.00	1.80	2.00	2.33	2.31	1.75	2.13	2.31	2.31	2.00	1.63	2.19	2.22
171	2.45	1.36	1.91	2.36	2.55	2.18	2.09	2.45	2.17	3.20	1.80	3.00	3.60	3.40	3.80	2.80	3.20	3.10	2.69	1.50	2.25	2.75	2.81	2.69	2.31	2.69	2.46
172	3.82	1.73	2.82	3.09	3.64	2.55	2.45	3.18	2.91	3.40	1.80	2.60	3.40	3.20	2.80	3.00	3.00	2.90	3.69	1.75	2.75	3.19	3.50	2.63	2.63	3.13	2.91
173	3.55	2.36	2.91	2.82	3.36	2.36	2.55	3.00	2.86	4.00	2.00	2.80	4.40	4.20	3.40	3.20	4.00	3.50	3.69	2.25	2.88	3.31	3.63	2.69	2.75	3.31	3.06
174	2.73	1.45	1.82	2.18	1.36	1.45	1.64	1.73	1.80	3.00	1.00	2.20	2.60	2.80	2.00	2.60	2.60	2.35	2.81	1.31	1.94	2.31	1.81	1.63	1.94	2.00	1.97
175	3.18	2.27	2.82	3.09	3.00	2.18	2.36	2.82	2.72	3.60	3.00	3.00	3.00	2.80	3.20	2.40	3.40	3.05	3.31	2.50	2.88	3.06	2.94	2.50	2.38	3.00	2.82
176	1.91	2.18	2.18	1.64	1.82	1.73	1.36	1.82	1.83	2.20	3.60	3.60	2.20	2.60	2.60	1.60	2.20	2.58	2.00	2.63	2.63	1.81	2.06	2.00	1.44	1.94	2.06
177	1.18	0.82	1.18	0.82	0.91	1.09	0.82	0.91	1.06	1.60	2.60	3.60	1.40	1.80	3.20	1.40	1.60	2.15	1.31	1.38	1.94	1.00	1.19	1.75	1.00	1.13	1.43
178	0.91	0.73	1.09	0.73	0.82	1.00	0.73	0.91	0.95	1.60	2.20	3.60	1.40	1.80	2.80	1.40	1.60	2.05	1.13	1.19	1.88	0.94	1.13	1.56	0.94	1.13	1.32
179	2.27	2.18	2.55	2.36	2.18	2.09	1.45	2.18	2.16	3.40	2.60	3.00	3.40	2.80	2.40	2.40	3.40	2.93	2.63	2.31	2.69	2.69	2.38	2.19	1.75	2.56	2.40
180	2.09	1.09	1.18	2.00	0.64	0.73	1.27	1.18	1.40	1.40	0.80	1.60	2.20	0.60	1.60	2.00	1.60	1.48	1.88	1.00	1.31	2.06	0.63	1.00	1.50	1.31	1.43
181	2.45	1.09	1.55	2.27	1.09	0.91	1.45	1.73	1.73	1.40	0.80	1.60	2.20	1.20	1.40	1.80	1.80	1.53	2.13	1.00	1.56	2.25	1.13	1.06	1.56	1.75	1.66
182	3.00	1.18	1.64	2.55	1.00	1.18	1.55	1.45	1.74	1.40	1.20	2.00	2.20	1.40	2.00	1.80	1.80	1.73	2.50	1.19	1.75	2.44	1.13	1.44	1.63	1.56	1.82
183	2.09	1.09	1.82	1.91	1.09	1.09	1.27	1.45	1.63	1.40	0.80	1.60	2.20	1.40	1.60	1.80	1.80	1.58	1.88	1.00	1.75	2.00	1.19	1.25	1.44	1.56	1.61
184	2.09	0.91	1.64	1.73	0.91	0.91	1.27	1.27	1.48	1.40	0.80	1.60	2.20	1.40	2.00	1.80	1.80	1.63	1.88	0.88	1.63	1.88	1.06	1.25	1.44	1.44	1.53
185	1.64	0.91	1.82	1.73	1.27	0.91	1.09	1.18	1.45	1.40	0.60	1.40	2.20	1.00	1.60	1.60	1.60	1.43	1.56	0.81	1.69	1.88	1.19	1.13	1.25	1.31	1.44
186	2.55	1.82	2.00	2.91	1.64	1.55	1.55	2.00	2.20	3.40	2.40	2.60	3.80	3.20	3.80	2.60	4.00	3.23	2.81	2.00	2.19	3.19	2.13	2.25	1.88	2.63	2.54
187	2.36	1.73	1.91	2.64	1.55	1.45	1.55	1.91	2.08	3.40	2.40	2.60	3.00	3.20	3.80	2.60	3.60	3.08	2.69	1.94	2.13	2.75	2.06	2.19	1.88	2.44	2.41
188	2.55	2.18	1.91	2.27	2.55	1.64	1.36	2.36	2.31	3.00	2.80	2.60	2.60	3.20	3.00	1.80	3.20	2.78	2.69	2.38	2.13	2.38	2.75	2.06	1.50	2.63	2.47
189	2.55	2.18	1.91	2.36	2.36	1.73	1.36	2.36	2.31	2.60	3.20	3.20	2.20	2.80	3.40	1.80	2.80	2.75	2.56	2.50	2.31	2.31	2.50	2.25	1.50	2.50	2.46
190	2.09	1.91	2.00	1.73	1.64	1.55	1.36	1.55	1.90	2.60	2.40	2.80	2.20	2.80	2.20	1.40	2.80	2.40	2.25	2.06	2.25	1.88	2.00	1.75	1.38	1.94	2.07
191	1.73	0.55	1.18	1.82	1.73	1.09	1.45	1.27	1.49	1.60	0.80	1.80	1.60	1.20	1.40	0.80	1.20	1.30	1.69	0.63	1.38	1.75	1.56	1.19	1.25	1.25	1.43
192	2.45	1.45	1.64	2.00	1.73	1.64	1.45	1.82	1.77	3.00	2.00	2.20	3.20	2.20	2.00	2.00	2.60	2.40	2.63	1.63	1.81	2.38	1.88	1.75	1.63	2.06	1.97
193	2.00	1.18	1.36	2.00	1.91	1.36	1.36	1.55	1.59	3.00	1.20	2.40	3.20	3.40	2.40	1.60	3.00	2.53	2.31	1.19	1.69	2.38	2.38	1.69	1.44	2.00	1.88
194	2.09	1.45	1.73	2.27	1.73	1.18	1.55	1.64	1.70	2.00	1.40	1.80	1.80	1.60	1.40	1.00	1.20	1.53	2.06	1.44	1.75	2.13	1.69	1.25	1.38	1.50	1.65
195	2.64	1.64	1.91	2.64	2.27	1.55	1.55	2.18	2.05	2.00	1.00	1.80	2.20	2.00	1.40	1.40	1.60	1.68	2.44	1.44	1.88	2.50	2.19	1.50	1.50	2.00	1.93
196	1.45	0.82	1.27	1.45	1.18	0.91	0.73	0.91	1.20	1.80	0.80	0.80	1.80	1.60	1.20	1.20	1.60	1.35	1.56	0.81	1.13	1.56	1.31	1.00	0.88	1.13	1.25
197	1.73	1.00	1.45	1.64	1.18	0.91	1.00	1.27	1.40	2.40	1.40	1.80	2.20	2.40	1.80	1.80	2.40	2.03	1.94	1.13	1.56	1.81	1.56	1.19	1.25	1.63	1.61
198	2.82	1.09	1.55	2.82	2.64	1.64	1.64	2.27	2.06	2.40	1.20	1.60	2.80	3.40	2.40	2.00	2.80	2.33	2.69	1.13	1.56	2.81	2.88	1.88	1.75	2.44	2.14
199	1.91	1.00	1.73	2.00	1.91	1.27	1.00	1.27	1.51	1.20	0.80	0.80	1.40	1.60	1.00	0.80	1.20	1.10	1.69	0.94	1.44	1.81	1.81	1.19	0.94	1.25	1.38
200	1.91	1.00	1.27	1.73	1.55	1.36	1.36	1.36	1.44	1.00	0.80	0.80	1.40	0.80	0.60	1.40	1.00	0.98	1.63	0.94	1.13	1.63	1.31	1.13	1.38	1.25	1.30
201	2.64	1.36	1.73	2.64	3.00	2.00	1.73	2.36	2.18	3.00	1.40	2.20	3.00	2.60	2.80	2.40	3.00	2.55	2.75	1.38	1.88	2.75	2.88	2.25	1.94	2.56	2.30
202	2.00	1.45	1.73	2.09	2.18	1.27	1.18	1.73	1.88	2.00	1.20	1.60	2.40	1.60	1.40	1.80	1.60	1.70	2.00	1.38	1.69	2.19	2.00	1.31	1.38	1.69	1.82
203	3.00	2.00	1.91	2.73	2.73	2.36	1.64	2.64	2.38	3.00	1.80	1.80	3.00	3.00	2.40	2.40	3.00	2.55	3.00	1.94	1.88	2.81	2.81	2.38	1.88	2.75	2.43
204	1.64	1.09	1.45	1.82	1.55	1.36	1.36	1.64	1.64	1.60	0.80	0.80	1.80	1.40	1.00	0.80	0.80	1.13	1.63	1.00	1.25	1.81	1.50	1.25	1.19	1.38	1.47
205	1.82	1.09	1.45	2.00	1.73	1.55	1.36	1.64	1.74	1.60	0.80	1.20	1.80	1.40	1.00	1.60	1.20	1.33	1.75	1.00	1.38	1.94	1.63	1.38	1.44	1.50	1.60
206	2.82	1.73	1.91	2.45	1.91	2.00	1.45	2.64	2.11	1.60	1.20	1.20	1.80	1.20	0.80	1.60	1.60	1.38	2.44	1.56	1.69	2.25	1.69	1.63	1.50	2.31	1.88
207	3.36	2.18	2.27	2.55	3.27	3.00	1.82	3.00	2.68	2.60	2.60	2.20	2.60	3.40	3.00	2.00	3.00	2.68	3.13	2.31	2.25	2.56	3.31	3.00	1.88	3.00	2.68
208	2.64	1.64	1.55	2.18	1.91	1.73	1.64	2.09	1.92	2.00	1.00	1.20	2.00	2.00	1.40	1.80	1.60	1.63	2.44	1.44	1.44	2.13	1.94	1.63	1.69	1.94	1.83
209	2.64	1.45	1.73	2.27	1.91	1.55	1.45	1.91	1.86	2.00	1.00	1.20	2.40	2.00	1.40	1.80	2.00	1.73	2.44	1.31	1.56	2.31	1.94	1.50	1.56	1.94	1.82
210	2.09	1.36	1.55	2.27	2.09	1.36	1.18	1.91	1.73	2.00	0.80	1.20	2.00	1.60	1.20	1.60	1.60	1.50	2.06	1.19	1.44	2.19	1.94	1.31	1.31	1.81	1.66
211	1.73	1.27	1.27	2.18	1.64	1.27	1.09	1.45	1.64	2.60	1.40	2.20	2.20	3.40	2.80	2.40	2.60	2.45	2.00	1.31	1.56	2.19	2.19	1.75	1.50	1.81	1.91
212	2.55	1.45	1.91	2.36	1.55	1.55	1.55	1.64	2.00	3.00	2.60	2.20	3.00	3.60	3.00	2.80	3.00	2.90	2.69	1.81	2.00	2.56	2.19	2.00	1.94	2.06	2.30
213	3.45	2.36	2.18	2.73	2.55	1.82	1.73	2.73	2.69	2.20	1.80	2.20	2.60	1.60	2.20	1.60	2.20	2.05	3.06	2.19	2.19	2.69	2.25	1.94	1.69	2.56	2.48
214	3.73	3.73	3.36	3.00	3.00	2.64	1.82	3.55	3.10	3.60	3.20	4.00	3.60	4.00	3.60	2.00	3.60	3.45	3.69	3.56	3.56	3.19	3.31	2.94	1.88	3.56	3.21
215	2.82	2.64	2.64	2.45	2.09	1.91	1.55	2.64	2.34	2.20	1.40	2.60	3.60	3.60	3.60	2.80	3.00	2.85	2.63	2.25	2.63	2.81	2.56	2.44	1.94	2.75	2.50
216	3.00	2.82	3.18	2.45	2.09	2.64	1.91	2.82	2.61	2.40	2.00	2.40	2.00	2.20	2.40	0.80	2.00	2.03	2.81	2.56	2.94	2.31	2.13	2.56	1.56	2.56	2.43
217	3.09	2.36	2.73	2.55	1.64	2.18	1.64	2.55	2.58	2.60	1.60	2.80	3.00	2.80	2.00	2.00	2.40	2.40	2.94	2.13	2.75	2.69	2.00	2.13	1.75	2.50	2.52
218	3.09	2.55	2.73	2.55	2.55	2.55	1.64	2.91	2.83	2.60	2.60	3.00	2.40	2.80	2.80	1.00	2.60	2.48	2.94	2.56	2.81	2.50	2.63	2.63	1.44	2.81	2.71
219	2.36	2.36	2.18	2.18	1.45	1.64	1.27	2.00	2.13	2.60	1.80	2.60	3.00	2.00	2.00	2.00	2.20	2.28	2.44	2.19	2.31	2.44	1.63	1.75	1.50	2.06	2.18
220	2.00	1.09	1.55	1.64	1.82	1.64	1.36	1.64	1.75	2.40	1.60	2.20	2.40	1.80	1.60	1.60	2.40	2.00	2.13	1.25	1.75	1.88	1.81	1.63	1.44	1.88	1.83

APPENDIX B.1 - (CONT'D)

R & D PROJECT NUMBER	AVERAGES - OPERATING MEMBERS									AVERAGES - GOVERNMENT AGENCIES									AVERAGES - OPERATING & GOVERNMENT AGENCIES COMBINED								
	A	B	C	D	E	F	G	H	TOTAL AVERAGE	A	B	C	D	E	F	G	H	TOTAL AVERAGE	A	B	C	D	E	F	G	H	TOTAL AVERAGE
221	1.64	1.82	1.73	2.00	1.09	1.18	1.82	1.45	1.75	1.00	0.80	1.60	1.00	0.80	2.00	1.20	0.80	1.15	1.44	1.50	1.69	1.69	1.00	1.44	1.63	1.25	1.55
222	2.00	1.73	1.91	1.64	1.55	1.73	1.55	2.18	1.96	2.60	2.40	2.80	3.20	3.60	2.80	1.60	2.60	2.70	2.19	1.94	2.19	2.13	2.19	2.06	1.56	2.31	2.21
223	3.36	2.27	2.45	2.82	2.64	2.18	1.64	2.45	2.48	3.00	2.00	2.80	2.80	3.60	2.80	1.60	2.60	2.65	3.25	2.19	2.56	2.81	2.94	2.38	1.63	2.50	2.53
224	3.00	2.45	2.45	2.64	2.45	2.09	1.45	2.82	2.42	2.20	2.40	2.80	2.00	3.20	2.80	1.60	2.60	2.45	2.75	2.44	2.56	2.44	2.69	2.31	1.50	2.75	2.43
225	3.73	2.82	2.82	3.36	2.82	2.82	2.09	3.36	2.98	3.00	2.80	3.20	2.00	3.00	2.40	2.00	3.00	2.68	3.50	2.81	2.94	2.94	2.88	2.69	2.06	3.25	2.88
226	3.09	2.91	2.91	2.82	2.18	2.00	1.82	2.91	2.84	3.00	2.00	2.80	2.40	3.00	2.40	2.00	3.00	2.58	3.06	2.63	2.88	2.69	2.44	2.13	1.88	2.94	2.75
227	2.64	0.91	1.73	2.36	2.18	1.55	1.36	2.09	1.85	2.00	1.40	1.80	2.00	1.60	1.60	1.40	2.00	1.73	2.44	1.06	1.75	2.25	2.00	1.56	1.38	2.06	1.81
228	2.82	2.27	2.64	2.36	2.36	2.18	1.36	2.45	2.31	2.60	2.20	2.60	2.60	3.00	2.40	1.60	2.60	2.45	2.75	2.25	2.63	2.44	2.56	2.25	1.44	2.50	2.33
229	2.64	2.27	2.27	2.27	2.00	2.09	1.55	2.09	2.15	3.00	2.20	3.00	3.00	3.60	2.00	1.60	3.00	2.68	2.75	2.25	2.50	2.50	2.50	2.06	1.56	2.38	2.31
230	3.00	1.73	1.64	2.18	2.09	1.82	1.64	2.27	2.05	2.80	2.00	2.40	3.20	3.20	2.40	2.00	2.40	2.55	2.94	1.81	1.88	2.50	2.44	2.00	1.75	2.31	2.20
231	3.00	2.27	2.45	2.45	1.73	2.09	1.73	2.45	2.27	3.00	2.20	3.00	3.00	2.60	2.80	2.80	3.00	2.80	3.00	2.25	2.63	2.63	2.00	2.31	2.06	2.63	2.44
232	3.18	2.45	2.45	2.55	2.64	2.55	1.64	2.55	2.50	3.20	2.60	2.20	2.40	3.60	3.40	1.60	3.20	2.78	3.19	2.50	2.38	2.50	2.94	2.81	1.63	2.75	2.59
233	2.45	2.00	1.82	1.64	2.27	1.73	1.64	2.00	1.94	2.60	1.80	2.60	2.40	3.00	2.40	1.60	2.60	2.38	2.50	1.94	2.06	1.88	2.50	1.94	1.63	2.19	2.08
234	2.18	1.73	1.91	1.36	1.73	1.45	0.91	1.73	1.79	2.60	2.20	2.20	1.60	3.00	2.40	1.60	2.20	2.23	2.31	1.88	2.00	1.44	2.13	1.75	1.13	1.88	1.93
235	2.36	2.18	2.45	2.18	1.73	1.91	1.18	2.55	2.28	3.00	2.60	2.60	2.80	2.40	2.20	2.00	2.20	2.48	2.56	2.31	2.50	2.38	1.94	2.00	1.44	2.44	2.34
236	2.36	2.55	2.73	2.36	2.00	1.91	1.36	2.55	2.45	2.60	2.60	2.60	2.40	2.80	2.20	2.00	2.20	2.43	2.44	2.56	2.69	2.38	2.25	2.00	1.56	2.44	2.44
237	2.27	1.09	1.18	2.64	1.55	1.64	1.45	1.55	1.84	3.00	1.20	2.00	3.00	2.00	2.00	2.40	2.40	2.25	2.50	1.13	1.44	2.75	1.69	1.75	1.75	1.81	1.98
238	2.45	1.36	1.45	2.64	1.73	1.82	1.55	1.91	2.05	3.00	1.20	2.00	3.00	2.00	2.40	2.00	2.40	2.25	2.63	1.31	1.63	2.75	1.81	2.00	1.69	2.06	2.12
239	2.45	1.45	1.64	2.36	1.45	1.73	1.45	1.91	1.99	3.00	1.80	2.20	3.40	2.60	2.00	2.00	2.60	2.45	2.63	1.56	1.81	2.69	1.81	1.81	1.63	2.13	2.14
240	2.73	1.27	1.64	2.64	1.64	1.91	1.45	1.91	1.90	2.40	1.20	2.00	2.60	2.00	2.00	2.00	2.00	2.03	2.63	1.25	1.75	2.63	1.75	1.94	1.63	1.94	1.94
241	2.73	1.55	1.45	2.27	2.09	1.82	1.45	1.82	1.90	2.20	1.00	1.40	2.40	1.40	1.40	1.40	1.40	1.58	2.56	1.38	1.44	2.31	1.88	1.69	1.44	1.69	1.80
242	2.36	1.09	1.45	2.27	1.45	1.36	1.09	1.55	1.58	3.20	2.00	2.00	3.40	2.00	2.00	1.60	2.00	2.28	2.63	1.38	1.63	2.63	1.63	1.56	1.25	1.69	1.88
243	2.82	1.73	1.91	2.36	2.27	2.00	1.55	2.36	2.34	3.00	2.20	2.20	3.00	2.60	3.00	1.60	2.60	2.53	2.88	1.88	2.00	2.56	2.38	2.31	1.56	2.44	2.40
244	2.27	1.36	1.36	2.18	1.82	0.91	1.00	1.82	1.75	3.00	2.40	2.60	3.00	2.80	2.80	2.00	3.00	2.70	2.50	1.69	1.75	2.44	2.13	1.50	1.31	2.19	2.07
245	3.27	1.82	1.82	3.18	2.91	1.91	4.36	2.09	2.36	3.00	2.00	2.40	3.40	2.60	2.40	2.60	2.60	2.63	3.19	1.88	2.00	3.25	2.81	2.06	3.81	2.25	2.68
246	0.55	1.18	1.18	0.73	0.82	0.91	0.55	0.73	1.01	1.80	2.60	2.20	2.20	2.40	2.00	1.20	1.80	2.03	0.94	1.63	1.50	1.19	1.31	1.25	0.75	1.06	1.38
247	2.36	1.55	1.73	2.55	2.27	1.91	1.45	2.36	2.23	2.40	1.20	2.00	2.40	2.80	2.80	2.20	2.40	2.28	2.38	1.44	1.81	2.50	2.44	2.19	1.69	2.38	2.24
248	2.64	1.36	1.45	2.82	2.55	1.73	1.64	2.27	2.06	2.40	1.00	1.40	2.40	2.40	2.60	2.40	2.40	2.13	2.56	1.25	1.44	2.69	2.50	2.00	1.88	2.31	2.08
249	2.82	1.64	1.82	2.45	2.27	1.64	1.45	2.09	2.02	3.00	2.00	1.60	2.80	2.40	2.40	2.80	2.40	2.43	2.88	1.75	1.75	2.56	2.31	1.88	1.88	2.19	2.15
250	3.36	1.91	2.18	3.36	2.82	2.27	1.82	2.64	2.55	2.80	1.40	1.40	2.20	1.80	1.80	2.60	2.20	2.03	3.19	1.75	1.94	3.00	2.50	2.13	2.06	2.50	2.38
251	3.45	1.55	1.82	2.73	2.27	1.91	1.36	2.73	2.23	2.40	1.20	1.60	2.40	2.00	1.40	2.20	2.40	1.95	3.13	1.44	1.75	2.63	2.19	1.75	1.63	2.63	2.14
252	3.64	1.36	2.00	2.73	2.73	1.73	1.55	2.73	2.31	3.00	2.20	1.80	3.00	3.40	3.00	3.00	3.00	2.80	3.44	1.63	1.94	2.81	2.94	2.13	2.00	2.81	2.46
253	3.55	1.36	2.45	3.36	3.18	3.36	3.00	3.36	2.95	3.40	1.00	1.40	4.00	4.00	3.40	3.20	3.80	3.03	3.50	1.25	2.13	3.56	3.44	3.38	3.06	3.50	2.98
254	3.55	1.36	1.91	3.55	3.55	2.64	2.09	2.82	2.68	3.40	1.20	1.60	3.20	3.60	2.40	3.20	3.40	2.75	3.50	1.31	1.81	3.44	3.56	2.56	2.44	3.00	2.70
255	3.91	2.09	2.64	4.09	3.91	3.18	2.82	3.73	3.30	3.40	1.60	2.00	4.00	4.00	2.40	3.40	3.40	3.03	3.75	1.94	2.44	4.06	3.94	2.94	3.00	3.63	3.21
256	3.91	1.91	2.09	3.73	3.73	3.00	2.82	3.55	3.09	3.60	1.80	2.20	4.00	4.00	3.00	3.40	3.80	3.23	3.81	1.88	2.13	3.81	3.81	3.00	3.00	3.63	3.13
257	4.09	1.73	2.45	3.91	3.73	2.82	2.82	3.36	3.11	2.80	0.60	1.80	3.20	2.60	1.80	2.40	2.40	2.20	3.69	1.38	2.25	3.69	3.38	2.50	2.69	3.06	2.83
258	2.82	1.18	1.64	2.64	2.82	1.91	1.91	2.64	2.19	2.80	0.80	2.00	2.80	2.80	1.60	2.20	2.80	2.23	2.81	1.06	1.75	2.69	2.81	1.81	2.00	2.69	2.20
259	2.45	1.18	1.45	2.45	2.82	1.73	1.36	1.91	1.92	2.80	1.00	2.40	2.80	3.20	2.20	2.20	2.80	2.43	2.56	1.13	1.75	2.56	2.94	1.88	1.63	2.19	2.08
260	4.09	2.18	2.64	3.73	3.36	3.36	2.45	3.18	3.13	4.40	2.40	2.40	4.40	4.40	2.80	3.20	3.20	3.40	4.19	2.25	2.56	3.94	3.69	3.19	2.69	3.19	3.21
261	3.36	1.82	2.45	2.82	2.82	2.45	1.73	3.18	2.58	3.00	1.00	1.40	3.00	2.60	1.80	2.20	2.60	2.20	3.25	1.56	2.13	2.88	2.75	2.25	1.88	3.00	2.46
262	3.18	1.64	1.73	2.82	1.91	1.91	1.36	2.64	2.15	2.60	1.20	1.60	2.20	2.20	1.60	2.00	2.60	2.00	3.00	1.50	1.69	2.63	2.00	1.81	1.56	2.63	2.10
263	2.82	1.64	2.00	2.45	1.91	1.73	1.36	2.27	2.02	3.40	1.80	3.00	3.00	2.80	2.80	2.40	3.00	2.78	3.00	1.69	2.31	2.63	2.19	2.06	1.69	2.50	2.26
264	3.00	2.09	2.27	2.45	2.27	1.73	1.55	2.82	2.27	3.80	2.20	2.60	2.60	3.00	2.40	2.40	3.00	2.75	3.25	2.13	2.38	2.50	2.50	1.94	1.81	2.88	2.42
265	3.00	1.45	2.45	2.64	1.36	1.55	1.18	2.45	2.01	3.00	2.60	3.00	3.00	2.80	1.60	2.00	3.00	2.63	3.00	1.81	2.63	2.75	1.81	1.56	1.44	2.63	2.20
266	3.36	2.09	2.09	2.45	1.45	1.73	1.55	2.09	2.10	2.20	1.00	1.40	2.20	1.40	1.00	1.80	1.40	1.55	3.00	1.75	1.88	2.38	1.44	1.50	1.63	1.88	1.93
267	3.36	1.64	2.45	2.45	1.55	1.91	1.55	2.27	2.15	3.20	2.00	2.40	2.80	1.40	1.60	2.00	2.00	2.18	3.31	1.75	2.44	2.56	1.50	1.81	1.69	2.19	2.16
268	2.82	1.73	2.09	2.27	1.36	1.73	1.55	1.91	1.93	2.40	2.00	2.40	2.20	1.40	1.60	1.80	2.00	1.98	2.69	1.81	2.19	2.25	1.38	1.69	1.63	1.94	1.95
269	3.00	2.27	2.45	2.82	2.09	2.27	1.73	2.73	2.42	3.00	2.40	2.60	2.60	2.20	1.80	2.00	3.00	2.45	3.00	2.31	2.50	2.75	2.13	2.13	1.81	2.81	2.43
270	3.18	1.45	2.27	3.00	2.64	2.27	1.73	3.00	2.44	3.80	2.20	2.80	2.60	3.00	2.80	2.20	3.00	2.80	3.38	1.69	2.44	2.88	2.75	2.44	1.88	3.00	2.55
271	2.27	1.00	1.36	2.45	2.27	1.91	1.36	1.91	1.82	1.80	0.80	1.20	1.80	2.60	1.20	1.60	1.80	1.60	2.13	0.94	1.31	2.25	2.38	1.69	1.44	1.88	1.75
272	3.18	1.45	2.09	3.00	2.64	2.45	2.09	2.82	2.47	3.40	2.00	2.00	3.80	3.00	2.80	2.80	3.40	2.90	3.25	1.63	2.06	3.25	2.75	2.56	2.31	3.00	2.68
273	3.36	2.00	2.27	3.18	2.64	3.36	3.36	3.18	2.92	2.80	1.00	1.40	2.80	2.80	3.00	3.00	3.20	2.50	3.19	1.69	2.00	3.06	2.69	3.25	3.25	3.19	2.79
274	3.00	1.45	1.91	3.00	2.27	2.09	1.55	2.64	2.24	3.40	2.20	2.60	3.80	2.80	2.80	3.20	3.00	2.98	3.13	1.69	2.13	3.25	2.44	2.31	2.06	2.75	2.47
275	4.09	3.18	2.64	4.09	3.64	3.27	3.27	4.00	3.52	4.40	1.40	1.80	4.40	3.40	3.80	3.40	4.00	3.33	4.19	2.63	2.38	4.19	3.56	3.44	3.31	4.00	3.46

APPENDIX B.1 - (CONT'D)

R & D PROJECT NUMBER	AVERAGES - OPERATING MEMBERS									AVERAGES - GOVERNMENT AGENCIES									AVERAGES - OPERATING & GOVERNMENT AGENCIES COMBINED								
	A	B	C	D	E	F	G	H	TOTAL AVERAGE	A	B	C	D	E	F	G	H	TOTAL AVERAGE	A	B	C	D	E	F	G	H	TOTAL AVERAGE
276	3.73	3.00	2.45	3.36	2.73	2.55	2.36	3.27	2.93	2.80	1.60	2.20	4.00	2.80	2.80	2.40	3.00	2.70	3.44	2.56	2.38	3.56	2.75	2.63	2.38	3.19	2.86

APPENDIX B.2 - MEASURES OF VARIANCE

Formula's Used

a) Standard Deviation

$$\sqrt{\frac{\Sigma (x - \bar{x})}{n - 1}}$$

Where:

x = Average score for each transit operator or government agency respondent.

$\bar{x}$ = Average score for all transit operator or government agency respondents.

n = Number of scores included in calculation of average score.

b) "z" Scores

$$\frac{x - \bar{x}}{\text{Standard Deviation}}$$

Where:

x = Average score for government agency respondents.

$\bar{x}$ = Average score for all respondents.

Standard Deviation = Standard Deviation for all respondents.

APPENDIX B.2 - MEASURES OF VARIANCE

PROJECT NUMBER	TRANSIT OPERATORS			GOVERNMENT AGENCIES			COMBINED	
	AVERAGE SCORE	STANDARD DEVIATION	Z SCORE	AVERAGE SCORE	STANDARD DEVIATION	Z SCORE	AVERAGE SCORE	STANDARD DEVIATION
1	2.73	0.9824	-0.1325	3.13	0.8660	-2.1170	2.85	0.9379
2	2.16	1.2426	-0.2996	3.35	0.8404	-1.3613	2.53	1.2421
3	1.55	1.1240	-0.3567	2.95	0.9083	-0.8745	1.98	1.2306
4	2.82	0.5572	-0.2725	3.30	0.4108	-4.6302	2.97	0.5525
5	2.94	0.6456	-0.1879	3.30	0.4108	-4.4562	3.05	0.5933
6	3.10	1.1331	-0.1123	3.50	1.1180	-1.9047	3.23	1.1070
7	2.69	0.8649	-0.2566	3.48	1.0016	-2.0336	2.94	0.9520
8	1.33	0.4340	-0.0254	1.38	0.8385	-0.9023	1.34	0.5599
9	1.51	0.5822	-0.4817	2.70	0.4108	-1.9088	1.88	0.7712
10	1.73	1.2359	-0.0935	2.05	0.6708	-1.0735	1.83	1.0781
11	3.07	0.9410	-0.0262	3.15	1.1673	-1.9711	3.09	0.9773
12	2.13	1.2171	0.0228	2.03	1.8209	-0.1993	2.09	1.3689
13	2.55	0.4042	-0.2445	3.00	0.8244	-3.2069	2.69	0.5809
14	2.59	0.4261	-0.0795	2.75	0.9961	-2.6286	2.64	0.6256
15	2.92	0.6644	0.1209	2.65	0.8168	-2.8874	2.84	0.6993
16	1.27	0.6295	-0.0194	1.33	1.2857	-0.0040	1.29	0.8400
17	3.01	0.9881	0.0185	2.95	1.2519	-1.6826	2.99	1.0343
18	2.43	1.0145	-0.1692	3.00	1.1319	-1.4075	2.61	1.0497
19	2.50	1.0086	-0.2120	3.20	1.2425	-1.3543	2.73	1.1008
20	2.43	1.2377	-0.2610	3.38	0.9763	-1.4551	2.74	1.2133
21	2.06	0.7506	-0.3311	3.13	1.3405	-1.0060	2.42	1.0697
22	2.16	1.1009	-0.0345	2.30	1.8574	-0.2638	2.21	1.3302
23	2.68	1.4019	0.1638	1.98	1.8337	-0.3866	2.43	1.5385
24	3.14	1.4607	0.2044	2.28	1.2260	-1.1547	2.85	1.4065
25	2.99	1.3800	0.1829	2.25	1.2593	-1.1028	2.74	1.3442
26	2.60	1.5123	0.1340	1.98	1.4042	-0.6849	2.41	1.4631
27	2.80	1.3787	0.0249	2.70	0.7836	-1.6557	2.77	1.1971
28	2.64	1.5537	0.0637	2.35	1.1367	-1.0040	2.55	1.4045
29	2.55	1.4751	0.0052	2.53	0.4183	-1.7331	2.54	1.2237
30	2.79	1.4637	0.1870	1.98	1.4042	-0.7680	2.52	1.4484
31	3.05	1.5368	-0.0354	3.20	1.2796	-1.2899	3.10	1.4112
32	3.14	1.3482	-0.0420	3.30	1.3038	-1.4651	3.19	1.2886
33	2.71	1.5910	-0.1090	3.18	1.0592	-1.2785	2.87	1.4138
34	2.60	1.6789	-0.1344	3.23	1.3181	-0.9616	2.81	1.5497
35	2.53	1.7369	-0.1656	3.28	0.8496	-1.2753	2.78	1.5098
36	2.51	1.7435	-0.0328	2.68	1.6384	-0.5621	2.57	1.6515
37	2.51	1.7435	-0.1422	3.15	0.7975	-1.2900	2.73	1.4942
38	2.51	1.7435	-0.0743	2.94	1.5155	-0.6839	2.63	1.6353
39	2.44	1.8298	-0.0838	2.94	1.5155	-0.6250	2.58	1.7038
40	2.14	0.9834	-0.0575	2.30	0.7213	-1.6500	2.19	0.8886
41	2.86	1.1585	-0.0519	3.09	1.4119	-1.2802	2.93	1.1819
42	3.09	1.0445	-0.0022	3.10	1.8758	-0.9437	3.09	1.2906
43	2.64	0.8632	-0.0348	2.73	0.7093	-2.4574	2.66	0.7955
44	2.35	1.3333	-0.0713	2.68	1.7221	-0.5167	2.45	1.4141
45	1.74	1.1031	0.0515	1.58	1.0518	-0.6009	1.68	1.0510
46	1.88	0.9878	-0.1645	2.38	1.0897	-0.9398	2.04	1.0129
47	3.03	1.0372	0.0870	2.73	1.4588	-1.2757	2.93	1.1493
48	2.50	1.2247	0.0988	2.18	0.8642	-1.3927	2.39	1.0967
49	2.75	1.0672	0.1700	2.25	0.7706	-1.8489	2.58	0.9805
50	3.77	0.9582	0.1766	3.18	1.2612	-2.1985	3.59	1.0574
51	2.51	1.2948	-0.1540	3.13	1.1388	-1.2566	2.70	1.2449
52	2.36	1.3056	-0.1897	3.13	1.0680	-1.2226	2.60	1.2543
53	2.85	0.9068	-0.0608	3.03	1.1605	-1.8215	2.91	0.9595
54	1.71	1.3346	-0.3138	2.83	0.8273	-1.0071	2.11	1.2708
55	2.52	1.4682	-0.0992	2.93	0.7049	-1.5333	2.65	1.2676

APPENDIX B.2 -(CONT'D)

PROJECT NUMBER	TRANSIT OPERATORS			GOVERNMENT AGENCIES			COMBINED	
	AVERAGE SCORE	STANDARD DEVIATION	Z SCORE	AVERAGE SCORE	STANDARD DEVIATION	Z SCORE	AVERAGE SCORE	STANDARD DEVIATION
56	3.03	1.4275	0.0083	3.00	1.0753	-1.5088	3.02	1.2912
57	2.51	1.4439	0.0522	2.33	0.5420	-1.5941	2.45	1.1969
58	2.50	1.4530	0.0485	2.33	0.5420	-1.5785	2.44	1.2035
59	2.04	0.9429	-0.3459	2.95	0.1118	-2.5356	2.34	0.8794
60	2.83	0.8744	-0.0476	2.95	0.9747	-2.1608	2.87	0.8756
61	2.74	0.8828	0.0596	2.60	0.5477	-2.7883	2.69	0.7689
62	2.16	0.7355	-0.2151	2.60	0.1369	-3.3726	2.30	0.6404
63	1.64	0.5666	-0.0515	1.75	1.0607	-0.8432	1.68	0.7286
64	2.30	0.9037	-0.1243	2.63	0.8570	-1.7796	2.41	0.8718
65	0.89	0.6883	-0.2038	1.40	1.0840	0.0306	1.06	0.8383
66	1.60	0.8412	-0.2970	2.43	0.9169	-1.0349	1.88	0.9258
67	1.84	0.9015	-0.1692	2.28	0.7826	-1.3930	1.98	0.8620
68	1.96	1.2333	-0.1351	2.40	0.7038	-1.3014	2.11	1.0793
69	2.34	0.9466	-0.2470	3.10	1.0983	-1.4511	2.59	1.0291
70	1.53	0.8893	-0.2940	2.45	0.9253	-0.9193	1.82	0.9736
71	2.06	0.9864	-0.2255	2.83	1.1443	-1.0828	2.30	1.0645
72	2.10	0.9919	-0.1407	2.53	0.8310	-1.4951	2.23	0.9386
73	2.14	0.8945	-0.1026	2.43	1.0883	-1.2259	2.23	0.9341
74	2.30	0.8400	-0.1946	2.83	1.0062	-1.6335	2.48	0.8992
75	1.96	1.0376	-0.2396	2.83	1.4131	-0.6975	2.25	1.1999
76	2.46	1.3541	-0.1764	3.18	1.3393	-1.0108	2.70	1.3461
77	2.31	1.5492	-0.1581	3.00	1.2500	-0.8909	2.54	1.4498
78	2.35	1.2315	-0.0827	2.63	0.9100	-1.3813	2.44	1.1089
79	1.74	0.6782	-0.2954	2.38	0.6614	-1.7914	1.95	0.7193
80	1.88	0.7660	-0.2372	2.40	0.5956	-1.9716	2.05	0.7377
81	1.60	1.0083	-0.3383	2.63	0.6374	-1.2916	1.94	1.0098
82	2.33	1.2677	-0.2726	3.40	0.8023	-1.5172	2.66	1.2271
83	2.18	0.9265	-0.2863	2.95	0.6471	-1.9793	2.43	0.9025
84	2.42	0.9425	-0.2022	2.98	0.5184	-2.4218	2.59	0.8570
85	2.22	1.0248	-0.1795	2.73	0.3112	-2.3287	2.38	0.8862
86	1.85	1.0338	-0.2508	2.65	1.0093	-1.0415	2.12	1.0633
87	1.95	1.0930	-0.3083	3.05	0.7786	-1.3673	2.30	1.1104
88	2.05	0.8960	-0.1933	2.68	1.3908	-0.8049	2.26	1.0778
89	2.74	1.1223	0.0120	2.70	1.1096	-1.5019	2.72	1.0744
90	1.78	1.1504	-0.1119	2.10	0.8404	-1.0235	1.89	1.0283
91	2.48	1.3215	0.1604	1.83	1.1511	-0.8832	2.27	1.2708
92	1.64	1.0989	-0.0538	1.83	1.2042	-0.4484	1.70	1.0954
93	1.03	0.5394	-0.4843	2.50	0.8839	-0.6431	1.49	0.9459
94	2.97	0.9322	-0.1021	3.25	0.7706	-2.6267	3.05	0.8696
95	2.53	1.0841	-0.0544	2.75	1.6677	-0.7535	2.60	1.2393
96	2.50	1.0353	-0.1767	3.03	0.5618	-2.2644	2.66	0.9284
97	1.59	0.9092	-0.1903	2.18	1.2487	-0.5195	1.78	1.0291
98	1.75	0.8496	-0.1884	2.38	1.3750	-0.5501	1.95	1.0368
99	2.22	0.8752	-0.2277	2.83	0.6225	-2.1336	2.41	0.8360
100	2.10	0.9350	-0.1017	2.43	1.3852	-0.7725	2.21	1.0656
101	1.84	0.9224	-0.3328	2.80	0.7531	-1.4574	2.16	0.9642
102	1.68	0.8921	-0.0171	1.73	1.2450	-0.4571	1.69	0.9773
103	2.77	0.9696	-0.0273	2.88	1.6724	-0.9657	2.80	1.1726
104	2.36	0.9690	-0.2890	3.23	0.5184	-2.2700	2.63	0.9315
105	2.31	0.9158	-0.1163	2.73	1.5772	-0.7657	2.44	1.1236
106	3.53	1.0460	-0.0388	3.65	0.7202	-3.0542	3.57	0.9331
107	2.74	0.9802	-0.0785	3.00	1.2624	-1.4982	2.82	1.0398
108	2.36	0.9944	-0.2968	3.30	0.6471	-2.0380	2.66	0.9858
109	0.86	0.5603	-0.4961	2.30	0.7159	-0.6593	1.31	0.9048
110	1.90	1.1427	0.0131	1.85	1.2575	-0.5500	1.88	1.1369

APPENDIX B.2 - (CONT'D)

	TRANSIT OPERATORS			GOVERNMENT AGENCIES			COMBINED	
PROJECT NUMBER	AVERAGE SCORE	STANDARD DEVIATION	Z SCORE	AVERAGE SCORE	STANDARD DEVIATION	Z SCORE	AVERAGE SCORE	STANDARD DEVIATION
111	2.50	1.1950	-0.0534	2.70	1.2393	-1.1301	2.56	1.1708
112	2.60	1.1684	-0.2250	3.40	0.8023	-1.8496	2.85	1.1079
113	3.41	1.0504	-0.0819	3.65	0.6021	-3.1345	3.48	0.9196
114	2.80	1.2340	-0.2560	3.75	0.7071	-2.0486	3.09	1.1650
115	2.26	1.1644	-0.3208	3.38	0.7706	-1.6117	2.63	1.1558
116	2.41	0.8662	-0.3842	3.60	0.6519	-2.1979	2.78	0.9688
117	2.67	1.2353	-0.2238	3.50	0.7906	-1.8468	2.93	1.1583
118	2.19	0.8503	-0.2108	2.88	1.2748	-1.1193	2.41	1.0109
119	2.21	0.8601	-0.1106	2.58	1.5502	-0.7169	2.33	1.0925
120	2.43	0.7549	-0.0722	2.68	1.6384	-0.8255	2.51	1.0532
121	3.50	0.9203	-0.1950	4.03	0.5477	-3.7043	3.66	0.8413
122	3.49	0.9159	-0.0282	3.58	1.1579	-2.4602	3.52	0.9584
123	3.22	1.0095	-0.1490	3.68	0.8642	-2.5918	3.36	0.9627
124	3.64	0.9137	-0.2165	4.18	0.5274	-3.9744	3.82	0.8276
125	3.38	1.0016	-0.0340	3.48	0.8120	-2.8190	3.41	0.9203
126	3.28	0.8911	-0.2139	3.83	0.3260	-3.9564	3.45	0.7904
127	2.50	1.1278	-0.1800	3.10	0.7624	-1.8478	2.69	1.0418
128	3.49	0.9023	-0.0432	3.60	0.8944	-3.0276	3.53	0.8689
129	3.32	1.0313	-0.0900	3.60	0.9287	-2.5322	3.41	0.9784
130	2.39	0.8629	0.0136	2.35	1.1264	-1.3611	2.38	0.9173
131	3.58	0.8593	0.0970	3.33	0.7886	-3.3053	3.50	0.8203
132	2.23	0.9301	-0.0208	2.30	1.5248	-0.6626	2.25	1.0945
133	2.57	0.9072	0.0770	2.30	1.5248	-0.8814	2.48	1.0886
134	2.52	0.9566	-0.1237	3.00	1.7230	-0.7869	2.67	1.2058
135	2.60	1.0560	-0.0757	2.90	1.6733	-0.8316	2.70	1.2290
136	1.91	0.8199	-0.3994	3.18	0.7886	-1.5306	2.30	0.9905
137	2.30	0.8914	-0.3522	3.38	0.6731	-2.0457	2.63	0.9579
138	1.78	0.6892	-0.2210	2.53	1.7148	-0.2742	2.03	1.1311
139	1.95	0.8212	-0.2886	2.78	1.6751	-0.6226	2.19	0.8230
140	1.97	0.6151	-0.3192	2.78	1.6548	-0.7760	2.18	0.6812
141	1.66	0.7502	-0.2426	2.53	1.6163	-0.2810	1.93	1.1152
142	1.85	0.8566	-0.3845	3.18	0.9984	-1.1786	2.27	1.0752
143	2.23	0.5831	-0.3039	2.85	0.5956	-2.8517	2.42	0.6404
144	2.64	0.9527	-0.2076	3.28	0.9203	-1.9925	2.84	0.9615
145	1.82	0.8336	-0.3776	2.98	0.7416	-1.5021	2.18	0.9574
146	1.60	0.7328	-0.3930	2.85	1.0055	-0.9946	1.99	0.9921
147	1.84	0.8103	-0.3877	3.00	0.6903	-1.6194	2.20	0.9342
148	2.19	0.9260	-0.1816	2.70	0.6993	-1.8942	2.35	0.8723
149	1.21	0.4550	-0.3880	2.10	1.0658	-0.5617	1.53	0.8207
150	2.13	1.0000	-0.0310	2.23	1.3358	-0.7653	2.16	1.0747
151	1.74	1.1569	-0.1287	2.18	1.1511	-0.6461	1.88	1.1334
152	2.24	1.0701	-0.0515	2.40	0.8450	-1.4739	2.29	0.9797
153	3.08	0.8984	-0.0604	3.25	0.9354	-2.4912	3.13	0.8821
154	2.35	0.8889	-0.2612	3.15	0.9454	-1.7353	2.60	0.9544
155	2.36	1.0254	-0.0729	2.65	1.7194	-0.5975	2.45	1.2280
156	2.85	0.7922	-0.0912	3.10	1.0398	-2.2260	2.93	0.8490
157	2.73	0.9887	-0.2345	3.48	0.8944	-2.0736	2.96	0.9966
158	2.17	0.7099	-0.3402	2.80	0.3260	-3.1090	2.39	0.6648
159	1.52	0.6145	-0.1830	2.05	1.3624	-0.3611	1.69	0.9002
160	2.63	0.7728	-0.0682	2.78	0.7202	-2.6663	2.68	0.7331
161	2.41	0.8218	-0.1906	2.88	0.5590	-2.6131	2.55	0.7637
162	2.82	0.8355	-0.1647	3.28	0.9454	-2.3250	2.96	0.8669
163	2.32	0.9072	-0.2804	3.23	1.0323	-1.5528	2.60	1.0106
164	1.61	0.7835	-0.3530	2.73	1.0170	-0.9593	1.96	0.9840
165	2.70	1.0699	0.1342	2.30	0.5701	-2.1318	2.58	0.9419

APPENDIX B.2 - (CONT'D)

PROJECT NUMBER	TRANSIT OPERATORS			GOVERNMENT AGENCIES			COMBINED	
	AVERAGE SCORE	STANDARD DEVIATION	Z SCORE	AVERAGE SCORE	STANDARD DEVIATION	Z SCORE	AVERAGE SCORE	STANDARD DEVIATION
166	2.05	0.7711	0.0686	1.85	1.2068	-0.8730	1.98	0.8908
167	2.32	0.8204	0.0057	2.30	1.4076	-0.9155	2.31	0.9885
168	2.20	0.7642	-0.3496	3.03	0.5333	-2.4685	2.48	0.7866
169	2.02	0.9028	-0.3441	3.03	0.4541	-2.0673	2.34	0.9103
170	2.16	0.6563	-0.0566	2.33	1.4885	-0.7607	2.22	0.9572
171	2.17	0.8183	-0.3433	3.10	0.5184	-2.2955	2.46	0.8462
172	2.91	0.9970	0.0024	2.90	1.6355	-1.0833	2.91	1.1730
173	2.86	1.1408	-0.1954	3.50	0.5303	-2.4885	3.06	1.0176
174	1.80	0.8629	-0.1667	2.35	1.3874	-0.5593	1.97	1.0393
175	2.72	1.1376	-0.1048	3.05	0.6225	-2.2071	2.82	0.9958
176	1.83	1.2812	-0.1929	2.58	0.9421	-0.9278	2.06	1.2076
177	1.06	0.9247	-0.3281	2.15	1.1673	-0.2333	1.43	1.1048
178	0.95	0.9208	-0.3461	2.05	1.0062	-0.2930	1.32	1.0595
179	2.16	0.8553	-0.2615	2.93	0.8997	-1.6373	2.40	0.9154
180	1.40	0.7542	-0.0325	1.48	0.8856	-0.7015	1.43	0.7688
181	1.73	1.0521	0.0686	1.53	0.8856	-0.7948	1.66	0.9722
182	1.86	0.8867	0.0470	1.73	1.2450	-0.5857	1.82	0.9761
183	1.63	0.8539	0.0192	1.58	0.9984	-0.7023	1.61	0.8684
184	1.48	0.7565	-0.0612	1.63	1.0155	-0.6234	1.53	0.8172
185	1.45	0.7125	0.0107	1.43	0.9984	-0.5669	1.44	0.7819
186	2.20	0.9113	-0.3522	3.23	0.7416	-1.8554	2.54	0.9702
187	2.08	1.0804	-0.3186	3.08	0.6098	-1.7189	2.41	1.0463
188	2.31	0.8765	-0.1977	2.78	0.4710	-2.5590	2.47	0.7799
189	2.31	0.9705	-0.1695	2.75	0.5590	-2.2074	2.46	0.8604
190	1.90	0.7656	-0.2180	2.40	0.7202	-1.7611	2.07	0.7645
191	1.49	1.0332	0.0639	1.30	0.9585	-0.4768	1.43	0.9783
192	1.77	0.8711	-0.2222	2.40	0.8263	-1.2951	1.97	0.8821
193	1.59	1.0608	-0.2948	2.53	0.3354	-1.5630	1.88	0.9900
194	1.70	0.7464	0.0724	1.53	0.9117	-0.9507	1.65	0.7749
195	2.05	0.8629	0.1273	1.68	1.0592	-0.9572	1.93	0.9094
196	1.20	0.6567	-0.0619	1.35	1.1367	-0.1403	1.25	0.8073
197	1.40	1.0766	-0.1887	2.03	1.1538	-0.4118	1.61	1.1038
198	2.06	0.6259	-0.1315	2.33	0.6937	-2.2708	2.14	0.6372
199	1.51	0.7974	0.1561	1.10	0.8988	-0.5878	1.38	0.8234
200	1.44	1.0021	0.1603	0.98	0.6519	-0.7066	1.30	0.9127
201	2.18	0.7753	-0.1744	2.55	0.1118	-3.3124	2.30	0.6597
202	1.88	0.9789	0.0570	1.70	1.2171	-0.5861	1.82	1.0230
203	2.38	0.8997	-0.0721	2.55	0.3260	-2.7745	2.43	0.7582
204	1.64	0.8709	0.1921	1.13	0.9186	-0.6162	1.47	0.8895
205	1.74	0.9903	0.1360	1.33	1.1096	-0.4849	1.60	1.0113
206	2.11	1.1312	0.2025	1.38	1.0969	-0.6896	1.88	1.1397
207	2.68	0.9226	0.0028	2.68	0.1677	-3.3129	2.68	0.7582
208	1.92	0.9224	0.0971	1.63	1.0897	-0.7767	1.83	0.9507
209	1.86	0.8090	0.0499	1.73	1.0840	-0.8479	1.82	0.8684
210	1.73	0.7198	0.0840	1.50	1.1592	-0.5876	1.66	0.8459
211	1.64	0.6304	-0.3776	2.45	0.5969	-1.8285	1.91	0.7172
212	2.00	0.8165	-0.3736	2.90	0.2850	-2.5096	2.30	0.8029
213	2.69	0.9705	0.2319	2.05	0.6937	-1.9438	2.48	0.9164
214	3.10	1.0381	-0.1222	3.45	0.4108	-3.1483	3.21	0.8894
215	2.34	1.0913	-0.1693	2.85	0.3354	-2.3031	2.50	0.9399
216	2.61	1.2215	0.1506	2.03	1.2512	-0.9649	2.43	1.2213
217	2.58	1.2307	0.0528	2.40	0.9117	-1.4540	2.52	1.1038
218	2.83	1.0869	0.1241	2.48	0.5755	-2.2695	2.71	0.9398
219	2.13	1.0223	-0.0547	2.28	0.7416	-1.5692	2.18	0.9134
220	1.75	0.7906	-0.1107	2.00	0.7235	-1.4749	1.83	0.7525

APPENDIX B.2 - (CONT'D)

PROJECT NUMBER	TRANSIT OPERATORS			GOVERNMENT AGENCIES			COMBINED	
	AVERAGE SCORE	STANDARD DEVIATION	Z SCORE	AVERAGE SCORE	STANDARD DEVIATION	Z SCORE	AVERAGE SCORE	STANDARD DEVIATION
221	1.75	0.8165	0.2219	1.15	1.0209	-0.5872	1.55	0.9011
222	1.96	1.2389	-0.2244	2.70	0.5420	-1.5211	2.21	1.0955
223	2.48	0.8475	-0.0723	2.65	0.5184	-2.6963	2.53	0.7465
224	2.42	0.8701	-0.0105	2.45	0.9906	-1.6436	2.43	0.8756
225	2.98	0.8906	0.1057	2.68	0.9666	-2.1438	2.88	0.8938
226	2.84	0.9205	0.1129	2.58	0.3708	-3.0704	2.75	0.7749
227	1.85	0.6345	0.0644	1.73	0.6398	-1.8992	1.81	0.6175
228	2.31	0.6878	-0.0741	2.45	0.4108	-3.2122	2.35	0.6042
229	2.15	1.1603	-0.1671	2.68	0.2092	-2.1324	2.31	0.9864
230	2.05	1.0357	-0.1630	2.55	0.7786	-1.4731	2.20	0.9670
231	2.27	0.8621	-0.2091	2.80	0.4809	-2.4832	2.44	0.7879
232	2.50	0.8588	-0.1132	2.78	0.5031	-2.7432	2.59	0.7593
233	1.94	0.8721	-0.1719	2.38	0.5000	-2.0101	2.08	0.7851
234	1.79	0.9683	-0.1677	2.23	0.6149	-1.5159	1.93	0.8697
235	2.28	0.8616	-0.0702	2.48	1.2068	-1.1944	2.34	0.9502
236	2.45	0.5869	0.0103	2.43	1.2362	-1.4859	2.44	0.8113
237	1.84	0.6097	-0.2485	2.25	0.3062	-3.0156	1.98	0.5534
238	2.05	0.6977	-0.1100	2.25	0.3953	-2.8410	2.12	0.6059
239	1.99	0.7299	-0.2274	2.45	0.4809	-2.4500	2.14	0.6779
240	1.90	0.9434	-0.0482	2.03	0.5618	-1.6667	1.94	0.8254
241	1.90	0.8493	0.1140	1.58	1.0216	-0.8761	1.80	0.8849
242	1.58	0.6478	-0.2988	2.28	0.7202	-1.4804	1.80	0.7273
243	2.34	0.7361	-0.0980	2.53	0.4183	-3.1074	2.40	0.6377
244	1.75	0.5270	-0.3858	2.70	0.9906	-1.3109	2.07	0.8209
245	2.36	1.1088	-0.0835	2.63	0.6731	-1.8123	2.45	0.9778
246	1.01	0.6264	-0.3983	2.03	1.0323	-0.3780	1.38	0.9067
247	2.23	1.2608	-0.0136	2.28	1.2821	-0.7856	2.24	1.2215
248	2.06	0.9243	-0.0218	2.13	1.1990	-0.9002	2.08	0.9767
249	2.02	0.9712	-0.1437	2.43	0.6098	-1.7591	2.15	0.8747
250	2.55	1.1226	0.1394	2.03	1.3122	-0.9176	2.38	1.1668
251	2.23	0.6865	0.1053	1.95	1.1374	-1.2194	2.14	0.8227
252	2.31	0.6456	-0.2623	2.80	0.2092	-3.8323	2.46	0.5876
253	2.95	1.2503	-0.0209	3.03	0.5031	-2.3468	2.98	1.0540
254	2.68	0.8011	-0.0303	2.75	0.5000	-3.1296	2.70	0.7040
255	3.30	0.8593	0.1009	3.03	0.8496	-2.8193	3.21	0.8376
256	3.09	0.9488	-0.0472	3.23	0.8310	-2.5922	3.13	0.8880
257	3.11	0.7384	0.2571	2.20	1.5949	-1.1106	2.83	1.1104
258	2.19	0.6259	-0.0116	2.23	1.3358	-1.0101	2.20	0.8586
259	1.92	0.5817	-0.1745	2.43	1.4131	-0.7360	2.08	0.9036
260	3.13	0.7685	-0.1282	3.40	0.3791	-4.2241	3.21	0.6704
261	2.58	0.9751	0.1138	2.20	1.2550	-1.1567	2.46	1.0426
262	2.15	0.6911	0.0677	2.00	0.7289	-2.0129	2.10	0.6819
263	2.02	0.6750	-0.3453	2.78	0.3354	-2.8238	2.26	0.6808
264	2.27	0.9840	-0.1735	2.75	0.3953	-2.3569	2.42	0.8598
265	2.01	0.5768	-0.3262	2.63	0.3750	-3.1098	2.20	0.5879
266	2.10	0.6774	0.2205	1.55	0.9421	-1.2620	1.93	0.7826
267	2.15	0.7177	-0.0126	2.18	0.6471	-2.2368	2.16	0.6747
268	1.93	0.8373	-0.0177	1.98	0.6519	-1.6966	1.95	0.7624
269	2.42	0.9815	-0.0111	2.45	0.4472	-2.3767	2.43	0.8341
270	2.44	0.4788	-0.1372	2.80	1.3393	-1.4956	2.55	0.8126
271	1.82	0.6407	0.0853	1.60	1.1538	-0.7455	1.75	0.7997
272	2.47	0.7248	-0.1989	2.90	0.5184	-3.0548	2.60	0.6819
273	2.92	0.9359	0.1204	2.50	1.4577	-1.2199	2.79	1.0914
274	2.24	0.6084	-0.3508	2.98	0.4710	-3.0457	2.47	0.6559
275	3.52	0.9250	0.0710	3.33	0.8178	-3.0364	3.46	0.8705

APPENDIX B.2 - (CONT'D)

PROJECT NUMBER	TRANSIT OPERATORS			GOVERNMENT AGENCIES			COMBINED	
	AVERAGE SCORE	STANDARD DEVIATION	Z SCORE	AVERAGE SCORE	STANDARD DEVIATION	Z SCORE	AVERAGE SCORE	STANDARD DEVIATION
276	2.93	0.8069	0.0815	2.70	1.1340	-1.9420	2.86	0.8864

APPENDIX B.3

RANKING OF PROJECTS BY SUBJECT CATEGORY

APPENDIX B.3 - RANKING OF PROJECTS BY SUBJECT CATEGORY

TRANSIT OPERATORS			GOVERNMENT AGENCIES			COMBINED		
PROJECT NUMBER	AVERAGE SCORE	GROUP RANKING	PROJECT NUMBER	AVERAGE SCORE	GROUP RANKING	PROJECT NUMBER	AVERAGE SCORE	GROUP RANKING
VEHICLE/SYSTEM TECHNOLOGY DEVELOPMENT			VEHICLE/SYSTEM TECHNOLOGY DEVELOPMENT			VEHICLE/SYSTEM TECHNOLOGY DEVELOPMENT		
1	2.73	22	1	3.13	18	1	2.85	17
2	2.16	58	2	3.35	5	2	2.53	46
3	1.55	83	3	2.95	32	3	1.98	76
4	2.82	17	4	3.30	6	4	2.97	10
5	2.94	12	5	3.30	6	5	3.05	7
6	3.10	4	6	3.50	1	6	3.23	2
7	2.69	24	7	3.48	2	7	2.94	11
8	1.33	86	8	1.38	87	8	1.34	86
9	1.51	85	9	2.70	48	9	1.88	80
10	1.73	78	10	2.05	79	10	1.83	82
11	3.07	6	11	3.15	16	11	3.09	5
12	2.13	63	12	2.03	80	12	2.09	73
13	2.55	31	13	3.00	27	13	2.69	29
14	2.59	30	14	2.75	44	14	2.64	34
15	2.92	13	15	2.65	53	15	2.84	19
16	1.27	87	16	1.33	88	16	1.29	87
17	3.01	10	17	2.95	32	17	2.99	9
18	2.43	45	18	3.00	27	18	2.61	36
19	2.50	40	19	3.20	11	19	2.73	25
20	2.43	46	20	3.38	4	20	2.74	23
21	2.06	65	21	3.13	18	21	2.42	55
22	2.16	58	22	2.30	72	22	2.21	68
23	2.68	25	23	1.98	81	23	2.43	53
24	3.14	2	24	2.28	74	24	2.85	17
25	2.99	11	25	2.25	76	25	2.74	23
26	2.60	28	26	1.98	81	26	2.41	56
27	2.80	18	27	2.70	48	27	2.77	22
28	2.64	26	28	2.35	69	28	2.55	43
29	2.55	31	29	2.53	60	29	2.54	44
30	2.79	19	30	1.98	81	30	2.52	47
31	3.05	7	31	3.20	11	31	3.10	4
32	3.14	2	32	3.30	6	32	3.19	3
33	2.71	23	33	3.18	13	33	2.87	15
34	2.60	28	34	3.23	10	34	2.81	20
35	2.53	33	35	3.28	9	35	2.78	21
36	2.51	35	36	2.68	50	36	2.57	42
37	2.51	35	37	3.15	16	37	2.73	25
38	2.51	35	38	2.94	37	38	2.63	35
39	2.44	44	39	2.94	37	39	2.58	40
40	2.14	61	40	2.30	72	40	2.19	69
41	2.86	14	41	3.09	24	41	2.93	12
42	3.09	5	42	3.10	22	42	3.09	5
43	2.64	26	43	2.73	45	43	2.66	31
44	2.35	49	44	2.68	51	44	2.45	49
45	1.74	76	45	1.58	85	45	1.68	84
46	1.88	72	46	2.38	67	46	2.04	75
47	3.03	8	47	2.73	45	47	2.93	12
48	2.50	40	48	2.18	78	48	2.39	58
49	2.75	20	49	2.25	76	49	2.58	40
50	3.77	1	50	3.18	13	50	3.59	1
51	2.51	35	51	3.13	18	51	2.70	27

APPENDIX B.3 - (CONT'D)

TRANSIT OPERATORS			GOVERNMENT AGENCIES			COMBINED		
PROJECT NUMBER	AVERAGE SCORE	GROUP RANKING	PROJECT NUMBER	AVERAGE SCORE	GROUP RANKING	PROJECT NUMBER	AVERAGE SCORE	GROUP RANKING
52	2.36	48	52	3.13	18	52	2.60	37
53	2.85	15	53	3.03	26	53	2.91	14
54	1.71	79	54	2.83	40	54	2.11	71
55	2.52	34	55	2.93	39	55	2.65	33
56	3.03	8	56	3.00	27	56	3.02	8
57	2.51	35	57	2.33	70	57	2.45	49
58	2.50	40	58	2.33	70	58	2.44	51
59	2.04	68	59	2.95	32	59	2.34	60
60	2.83	16	60	2.95	32	60	2.87	15
61	2.74	21	61	2.60	58	61	2.69	29
62	2.16	58	62	2.60	58	62	2.30	61
63	1.64	80	63	1.75	84	63	1.68	84
64	2.30	55	64	2.63	55	64	2.41	56
65	0.89	88	65	1.40	86	65	1.06	88
66	1.60	81	66	2.43	63	66	1.88	80
67	1.84	75	67	2.28	74	67	1.98	76
68	1.96	69	68	2.40	65	68	2.11	71
69	2.34	51	69	3.10	22	69	2.59	38
70	1.53	84	70	2.45	62	70	1.82	83
71	2.06	65	71	2.83	40	71	2.30	61
72	2.10	64	72	2.53	60	72	2.23	66
73	2.14	61	73	2.43	63	73	2.23	66
74	2.30	54	74	2.83	40	74	2.48	48
75	1.96	69	75	2.83	40	75	2.25	65
76	2.46	43	76	3.18	13	76	2.70	27
77	2.31	53	77	3.00	27	77	2.54	44
78	2.35	50	78	2.63	55	78	2.44	51
79	1.74	76	79	2.38	67	79	1.95	78
80	1.88	72	80	2.40	65	80	2.05	74
81	1.60	81	81	2.63	55	81	1.94	79
82	2.33	52	82	3.40	3	82	2.66	31
83	2.18	57	83	2.95	32	83	2.43	53
84	2.42	47	84	2.98	31	84	2.59	38
85	2.22	56	85	2.73	45	85	2.38	59
86	1.85	74	86	2.65	53	86	2.12	70
87	1.95	71	87	3.05	25	87	2.30	61
88	2.05	67	88	2.68	51	88	2.26	64
SERVICE & METHODS DEMONSTRATION			SERVICE & METHODS DEMONSTRATION			SERVICE & METHODS DEMONSTRATION		
89	2.74	6	89	2.70	19	89	2.72	10
90	1.78	24	90	2.10	26	90	1.89	24
91	2.48	13	91	1.83	28	91	2.27	20
92	1.64	27	92	1.83	29	92	1.70	27
93	1.03	29	93	2.50	21	93	1.49	29
94	2.97	3	94	3.25	9	94	3.05	4
95	2.53	10	95	2.75	17	95	2.60	15
96	2.50	11	96	3.03	11	96	2.66	11
97	1.59	28	97	2.18	25	97	1.78	26
98	1.75	25	98	2.38	23	98	1.95	23
99	2.22	19	99	2.83	15	99	2.41	18
100	2.10	21	100	2.43	22	100	2.21	21
101	1.84	23	101	2.80	16	101	2.16	22
102	1.68	26	102	1.73	30	102	1.69	28

APPENDIX B.3 - (CONT'D)

TRANSIT OPERATORS			GOVERNMENT AGENCIES			COMBINED		
PROJECT NUMBER	AVERAGE SCORE	GROUP RANKING	PROJECT NUMBER	AVERAGE SCORE	GROUP RANKING	PROJECT NUMBER	AVERAGE SCORE	GROUP RANKING
103	2.77	5	103	2.88	13	103	2.80	8
104	2.36	15	104	3.23	10	104	2.63	13
105	2.31	17	105	2.73	18	105	2.44	17
106	3.53	1	106	3.65	2	106	3.57	1
107	2.74	6	107	3.00	12	107	2.82	7
108	2.36	15	108	3.30	8	108	2.66	12
109	0.86	30	109	2.30	24	109	1.31	30
110	1.90	22	110	1.85	27	110	1.88	25
111	2.50	12	111	2.70	19	111	2.56	16
112	2.60	9	112	3.40	6	112	2.85	6
113	3.41	2	113	3.65	2	113	3.48	2
114	2.80	4	114	3.75	1	114	3.09	3
115	2.26	18	115	3.38	7	115	2.63	13
116	2.41	14	116	3.60	4	116	2.78	9
117	2.67	8	117	3.50	5	117	2.93	5
118	2.19	20	118	2.88	13	118	2.41	18
COMPUTER APPLICATIONS AND DEVELOPMENT			COMPUTER APPLICATIONS AND DEVELOPMENT			COMPUTER APPLICATIONS AND DEVELOPMENT		
119	2.21	35	119	2.58	43	119	2.33	38
120	2.43	24	120	2.68	41	120	2.51	27
121	3.50	3	121	4.03	2	121	3.66	2
122	3.49	4	122	3.58	7	122	3.52	4
123	3.22	9	123	3.68	4	123	3.36	9
124	3.64	1	124	4.18	1	124	3.82	1
125	3.38	6	125	3.48	9	125	3.41	7
126	3.28	8	126	3.83	3	126	3.45	6
127	2.50	23	127	3.10	20	127	2.69	19
128	3.49	5	128	3.60	6	128	3.53	3
129	3.32	7	129	3.60	5	129	3.41	7
130	2.39	26	130	2.35	48	130	2.38	35
131	3.58	2	131	3.33	12	131	3.50	5
132	2.23	33	132	2.30	51	132	2.25	43
133	2.57	21	133	2.30	51	133	2.48	28
134	2.52	22	134	3.00	26	134	2.67	21
135	2.60	20	135	2.90	30	135	2.70	18
136	1.91	47	136	3.18	17	136	2.30	40
137	2.30	31	137	3.38	11	137	2.63	22
138	1.78	53	138	2.53	45	138	2.03	51
139	1.95	46	139	2.78	36	139	2.19	46
140	1.97	45	140	2.78	37	140	2.18	47
141	1.66	55	141	2.53	45	141	1.93	56
142	1.85	48	142	3.18	17	142	2.27	42
143	2.23	33	143	2.85	33	143	2.42	32
144	2.64	18	144	3.28	13	144	2.84	16
145	1.82	51	145	2.98	28	145	2.18	48
146	1.60	57	146	2.85	33	146	1.99	52
147	1.84	49	147	3.00	26	147	2.20	45
148	2.19	37	148	2.70	40	148	2.35	36
149	1.21	59	149	2.10	58	149	1.53	59
150	2.13	42	150	2.23	55	150	2.16	49
151	1.74	54	151	2.18	56	151	1.88	57
152	2.24	32	152	2.40	47	152	2.29	41

APPENDIX B.3 - (CONT'D)

TRANSIT OPERATORS			GOVERNMENT AGENCIES			COMBINED		
PROJECT NUMBER	AVERAGE SCORE	GROUP RANKING	PROJECT NUMBER	AVERAGE SCORE	GROUP RANKING	PROJECT NUMBER	AVERAGE SCORE	GROUP RANKING
153	3.08	10	153	3.25	15	153	3.13	10
154	2.35	28	154	3.15	19	154	2.60	23
155	2.36	27	155	2.65	42	155	2.45	31
156	2.85	13	156	3.10	20	156	2.93	14
157	2.73	15	157	3.48	9	157	2.96	12
158	2.17	38	158	2.80	35	158	2.39	34
159	1.52	58	159	2.05	59	159	1.69	58
160	2.63	19	160	2.78	37	160	2.68	20
161	2.41	25	161	2.88	32	161	2.55	26
162	2.82	14	162	3.28	13	162	2.96	12
163	2.32	29	163	3.23	16	163	2.60	23
164	1.61	56	164	2.73	39	164	1.96	55
165	2.70	17	165	2.30	51	165	2.58	25
166	2.05	43	166	1.85	61	166	1.98	53
167	2.32	29	167	2.30	51	167	2.31	39
168	2.20	36	168	3.03	24	168	2.48	28
169	2.02	44	169	3.03	24	169	2.34	37
170	2.16	40	170	2.33	50	170	2.22	44
171	2.17	38	171	3.10	20	171	2.46	30
172	2.91	11	172	2.90	30	172	2.91	15
173	2.86	12	173	3.50	8	173	3.06	11
174	1.80	52	174	2.35	48	174	1.97	54
175	2.72	16	175	3.05	23	175	2.82	17
176	1.83	50	176	2.58	43	176	2.06	50
177	1.06	60	177	2.15	57	177	1.43	60
178	0.95	61	178	2.05	59	178	1.32	61
179	2.16	40	179	2.93	29	179	2.40	33
TRANSPORTATION PLANNING AND MANAGEMENT			TRANSPORTATION PLANNING AND MANAGEMENT			TRANSPORTATION PLANNING AND MANAGEMENT		
180	1.40	55	180	1.48	48	180	1.43	53
181	1.73	43	181	1.53	45	181	1.66	43
182	1.74	41	182	1.73	37	182	1.73	42
183	1.63	48	183	1.58	44	183	1.61	46
184	1.48	52	184	1.63	42	184	1.53	50
185	1.45	53	185	1.43	49	185	1.44	52
186	2.20	20	186	3.23	2	186	2.54	7
187	2.08	25	187	3.08	3	187	2.41	19
188	2.31	15	188	2.78	7	188	2.47	12
189	2.31	15	189	2.75	9	189	2.46	13
190	1.90	33	190	2.40	26	190	2.07	30
191	1.49	51	191	1.30	53	191	1.43	53
192	1.77	38	192	2.40	26	192	1.97	31
193	1.59	49	193	2.53	19	193	1.88	35
194	1.70	45	194	1.53	45	194	1.65	45
195	2.05	27	195	1.68	41	195	1.93	32
196	1.20	57	196	1.35	51	196	1.25	57
197	1.40	55	197	2.03	34	197	1.61	46
198	2.06	26	198	2.33	30	198	2.14	28
199	1.51	50	199	1.10	56	199	1.38	55
200	1.44	54	200	0.98	57	200	1.30	56
201	2.18	21	201	2.55	16	201	2.30	23
202	1.88	34	202	1.70	40	202	1.82	39

APPENDIX B.3 - (CONT'D)

TRANSIT OPERATORS			GOVERNMENT AGENCIES			COMBINED		
PROJECT NUMBER	AVERAGE SCORE	GROUP RANKING	PROJECT NUMBER	AVERAGE SCORE	GROUP RANKING	PROJECT NUMBER	AVERAGE SCORE	GROUP RANKING
203	2.38	13	203	2.55	16	203	2.43	16
204	1.64	46	204	1.13	55	204	1.47	51
205	1.74	41	205	1.33	52	205	1.60	48
206	2.11	24	206	1.38	50	206	1.88	35
207	2.68	6	207	2.68	11	207	2.68	5
208	1.92	32	208	1.63	42	208	1.83	37
209	1.86	35	209	1.73	37	209	1.82	39
210	1.73	43	210	1.50	47	210	1.66	43
211	1.64	46	211	2.45	22	211	1.91	34
212	2.00	29	212	2.90	4	212	2.30	23
213	2.69	5	213	2.05	33	213	2.48	11
214	3.10	1	214	3.45	1	214	3.21	1
215	2.34	14	215	2.85	5	215	2.50	10
216	2.61	7	216	2.03	34	216	2.43	16
217	2.58	8	217	2.40	26	217	2.52	9
218	2.83	4	218	2.48	20	218	2.71	4
219	2.13	23	219	2.28	31	219	2.18	27
220	1.75	39	220	2.00	36	220	1.83	37
221	1.75	39	221	1.15	54	221	1.55	49
222	1.96	30	222	2.70	10	222	2.21	25
223	2.48	10	223	2.65	14	223	2.53	8
224	2.42	12	224	2.45	22	224	2.43	16
225	2.98	2	225	2.68	11	225	2.88	2
226	2.84	3	226	2.58	15	226	2.75	3
227	1.85	36	227	1.73	37	227	1.81	41
228	2.31	15	228	2.45	22	228	2.35	20
229	2.15	22	229	2.68	11	229	2.31	22
230	2.05	27	230	2.55	16	230	2.20	26
231	2.27	19	231	2.80	6	231	2.44	14
232	2.50	9	232	2.78	7	232	2.59	6
233	1.94	31	233	2.38	29	233	2.08	29
234	1.79	37	234	2.23	32	234	1.93	32
235	2.28	18	235	2.48	20	235	2.34	21
236	2.45	11	236	2.43	25	236	2.44	14
POLICY AND PROGRAM DEVELOPMENT			POLICY & PROGRAM DEVELOPMENT			POLICY & PROGRAM DEVELOPMENT		
237	1.84	13	237	2.25	9	237	1.98	12
238	2.05	8	238	2.25	9	238	2.12	9
239	1.99	10	239	2.45	5	239	2.14	7
240	1.90	11	240	2.03	12	240	1.94	13
241	1.90	11	241	1.58	16	241	1.80	14
242	1.58	15	242	2.28	7	242	1.80	14
243	2.34	3	243	2.53	4	243	2.40	3
244	1.75	14	244	2.70	2	244	2.07	11
245	2.36	2	245	2.63	3	245	2.68	1
246	1.01	16	246	2.03	12	246	1.38	16
247	2.23	5	247	2.28	7	247	2.24	5
248	2.06	7	248	2.13	11	248	2.08	10
249	2.02	9	249	2.43	6	249	2.15	6
250	2.55	1	250	2.03	12	250	2.38	4
251	2.23	5	251	1.95	15	251	2.14	7
252	2.31	4	252	2.80	1	252	2.46	2

TRANSIT OPERATORS			GOVERNMENT AGENCIES			COMBINED		
PROJECT NUMBER	AVERAGE SCORE	GROUP RANKING	PROJECT NUMBER	AVERAGE SCORE	GROUP RANKING	PROJECT NUMBER	AVERAGE SCORE	GROUP RANKING
TRAINING & LABOUR RELATIONS			TRAINING/LABOUR RELATIONS			TRAINING/LABOUR RELATIONS		
253	2.95	4	253	3.03	2	253	2.98	3
254	2.68	5	254	2.75	4	254	2.70	5
255	3.30	1	255	3.03	2	255	3.21	1
256	3.09	3	256	3.23	1	256	3.13	2
257	3.11	2	257	2.20	7	257	2.83	4
258	2.19	6	258	2.23	6	258	2.20	6
259	1.92	7	259	2.43	5	259	2.08	7
DATA COLLECTION & ANALYSIS			DATA COLLECTION & ANALYSIS			DATA COLLECTION & ANALYSIS		
260	3.13	1	260	3.40	1	260	3.21	1
261	2.58	3	261	2.20	10	261	2.46	6
262	2.15	9	262	2.00	12	262	2.10	12
263	2.02	12	263	2.78	5	263	2.26	9
264	2.27	7	264	2.75	6	264	2.42	8
265	2.01	13	265	2.63	7	265	2.20	10
266	2.10	11	266	1.55	15	266	1.93	14
267	2.15	9	267	2.18	11	267	2.16	11
268	1.93	14	268	1.98	13	268	1.95	13
269	2.42	6	269	2.45	9	269	2.43	7
270	2.44	5	270	2.80	4	270	2.55	4
271	1.82	15	271	1.60	14	271	1.75	15
272	2.47	4	272	2.90	3	272	2.60	3
273	2.92	2	273	2.50	8	273	2.79	2
274	2.24	8	274	2.98	2	274	2.47	5
GENERAL TRANSPORTATION R & D			GENERAL TRANSPORTATION R & D			GENERAL TRANSPORTATION R & D		
275	3.52	1	275	3.33	1	275	3.46	1
276	2.93	2	276	2.70	2	276	2.86	2

APPENDIX B.4

OVERALL RANKING OF PROJECTS

APPENDIX B.4 - OVERALL RANKING OF PROJECTS

TRANSIT OPERATORS			GOVERNMENT AGENCIES			COMBINED		
PROJECT NUMBER	AVERAGE SCORE	OVERALL RANKING	PROJECT NUMBER	AVERAGE SCORE	OVERALL RANKING	PROJECT NUMBER	AVERAGE SCORE	OVERALL RANKING
1	2.73	55	1	3.13	52	1	2.85	45
2	2.16	160	2	3.35	25	2	2.53	107
3	1.55	256	3	2.95	81	3	1.98	212
4	2.82	45	4	3.30	28	4	2.97	31
5	2.94	33	5	3.30	28	5	3.05	26
6	3.10	19	6	3.50	12	6	3.23	14
7	2.69	60	7	3.48	15	7	2.94	34
8	1.33	267	8	1.38	267	8	1.34	270
9	1.51	259	9	2.70	126	9	1.88	230
10	1.73	237	10	2.05	226	10	1.83	236
11	3.07	24	11	3.15	49	11	3.09	22
12	2.13	170	12	2.03	230	12	2.09	201
13	2.55	79	13	3.00	71	13	2.69	70
14	2.59	75	14	2.75	116	14	2.64	81
15	2.92	35	15	2.65	141	15	2.84	48
16	1.27	268	16	1.33	270	16	1.29	274
17	3.01	28	17	2.95	81	17	2.99	29
18	2.43	105	18	3.00	71	18	2.61	86
19	2.50	91	19	3.20	42	19	2.73	62
20	2.43	105	20	3.38	22	20	2.74	60
21	2.06	178	21	3.13	52	21	2.42	137
22	2.16	160	22	2.30	197	22	2.21	177
23	2.68	62	23	1.98	239	23	2.43	131
24	3.14	15	24	2.28	204	24	2.85	45
25	2.99	29	25	2.25	209	25	2.74	60
26	2.60	71	26	1.98	238	26	2.41	140
27	2.80	47	27	2.70	126	27	2.77	58
28	2.64	66	28	2.35	190	28	2.55	101
29	2.55	79	29	2.53	158	29	2.54	104
30	2.79	49	30	1.98	239	30	2.52	109
31	3.05	25	31	3.20	42	31	3.10	21
32	3.14	15	32	3.30	29	32	3.19	18
33	2.71	58	33	3.18	44	33	2.87	42
34	2.60	71	34	3.23	37	34	2.81	53
35	2.53	82	35	3.28	32	35	2.78	56
36	2.51	86	36	2.68	134	36	2.57	99
37	2.51	86	37	3.15	49	37	2.73	62
38	2.51	86	38	2.94	86	38	2.63	82
39	2.44	103	39	2.94	86	39	2.58	96
40	2.14	168	40	2.30	197	40	2.19	184
41	2.86	38	41	3.09	61	41	2.93	35
42	3.09	21	42	3.10	56	42	3.09	22
43	2.64	66	43	2.73	121	43	2.66	76
44	2.35	120	44	2.68	134	44	2.45	123
45	1.74	232	45	1.58	257	45	1.68	251
46	1.88	209	46	2.38	186	46	2.04	209
47	3.03	26	47	2.73	121	47	2.93	35
48	2.50	91	48	2.18	218	48	2.39	147
49	2.75	51	49	2.25	209	49	2.58	96
50	3.77	1	50	3.18	44	50	3.59	3
51	2.51	86	51	3.13	52	51	2.70	66
52	2.36	115	52	3.13	52	52	2.60	88

APPENDIX B.4 - (CONT'D)

TRANSIT OPERATORS			GOVERNMENT AGENCIES			COMBINED		
PROJECT NUMBER	AVERAGE SCORE	OVERALL RANKING	PROJECT NUMBER	AVERAGE SCORE	OVERALL RANKING	PROJECT NUMBER	AVERAGE SCORE	OVERALL RANKING
53	2.85	40	53	3.03	65	53	2.91	39
54	1.71	240	54	2.83	100	54	2.11	198
55	2.52	84	55	2.93	88	55	2.65	80
56	3.03	26	56	3.00	71	56	3.02	28
57	2.51	86	57	2.33	193	57	2.45	123
58	2.50	91	58	2.33	193	58	2.44	126
59	2.04	187	59	2.95	81	59	2.34	154
60	2.83	43	60	2.95	81	60	2.87	42
61	2.74	52	61	2.60	150	61	2.69	70
62	2.16	160	62	2.60	150	62	2.30	160
63	1.64	244	63	1.75	247	63	1.68	251
64	2.30	135	64	2.63	145	64	2.41	140
65	0.89	275	65	1.40	266	65	1.06	276
66	1.60	250	66	2.43	174	66	1.88	230
67	1.84	216	67	2.28	204	67	1.98	212
68	1.96	195	68	2.40	180	68	2.11	198
69	2.34	123	69	3.10	56	69	2.59	93
70	1.53	257	70	2.45	168	70	1.82	239
71	2.06	178	71	2.83	100	71	2.30	160
72	2.10	174	72	2.53	158	72	2.23	174
73	2.14	168	73	2.43	174	73	2.23	174
74	2.30	135	74	2.83	100	74	2.48	113
75	1.96	195	75	2.83	100	75	2.25	171
76	2.46	101	76	3.18	44	76	2.70	66
77	2.31	129	77	3.00	71	77	2.54	104
78	2.35	120	78	2.63	145	78	2.44	126
79	1.74	232	79	2.38	186	79	1.95	219
80	1.88	209	80	2.40	180	80	2.05	208
81	1.60	250	81	2.63	145	81	1.94	222
82	2.33	126	82	3.40	19	82	2.66	76
83	2.18	156	83	2.95	81	83	2.43	131
84	2.42	108	84	2.98	78	84	2.59	93
85	2.22	148	85	2.73	121	85	2.38	149
86	1.85	213	86	2.65	141	86	2.12	196
87	1.95	198	87	3.05	63	87	2.30	160
88	2.05	182	88	2.68	134	88	2.26	169
89	2.74	52	89	2.70	126	89	2.72	64
90	1.78	225	90	2.10	224	90	1.89	229
91	2.48	98	91	1.83	243	91	2.27	167
92	1.64	244	92	1.83	243	92	1.70	248
93	1.03	272	93	2.50	164	93	1.49	262
94	2.97	31	94	3.25	35	94	3.05	26
95	2.53	82	95	2.75	116	95	2.60	88
96	2.50	91	96	3.03	65	96	2.66	76
97	1.59	253	97	2.18	218	97	1.78	245
98	1.75	228	98	2.38	186	98	1.95	219
99	2.22	148	99	2.83	100	99	2.41	140
100	2.10	174	100	2.43	174	100	2.21	177
101	1.84	216	101	2.80	105	101	2.16	189
102	1.68	242	102	1.73	248	102	1.69	249
103	2.77	50	103	2.88	94	103	2.80	54
104	2.36	115	104	3.23	37	104	2.63	82

APPENDIX B.4 - (CONT'D)

TRANSIT OPERATORS			GOVERNMENT AGENCIES			COMBINED		
PROJECT NUMBER	AVERAGE SCORE	OVERALL RANKING	PROJECT NUMBER	AVERAGE SCORE	OVERALL RANKING	PROJECT NUMBER	AVERAGE SCORE	OVERALL RANKING
105	2.31	129	105	2.73	121	105	2.44	126
106	3.53	4	106	3.65	6	106	3.57	4
107	2.74	52	107	3.00	71	107	2.82	51
108	2.36	115	108	3.30	28	108	2.66	76
109	0.86	276	109	2.30	197	109	1.31	272
110	1.90	205	110	1.85	243	110	1.88	230
111	2.50	91	111	2.70	126	111	2.56	100
112	2.60	71	112	3.40	19	112	2.85	45
113	3.41	9	113	3.65	6	113	3.48	8
114	2.80	47	114	3.75	4	114	3.09	22
115	2.26	141	115	3.38	22	115	2.63	82
116	2.41	111	116	3.60	8	116	2.78	56
117	2.67	65	117	3.50	12	117	2.93	35
118	2.19	153	118	2.88	94	118	2.41	140
119	2.21	150	119	2.58	152	119	2.33	157
120	2.43	105	120	2.68	134	120	2.51	111
121	3.50	6	121	4.03	2	121	3.66	2
122	3.49	7	122	3.58	11	122	3.52	6
123	3.22	14	123	3.68	5	123	3.36	13
124	3.64	2	124	4.18	1	124	3.82	1
125	3.38	10	125	3.48	15	125	3.41	11
126	3.28	13	126	3.83	3	126	3.45	10
127	2.50	91	127	3.10	56	127	2.69	70
128	3.49	7	128	3.60	8	128	3.53	5
129	3.32	11	129	3.60	8	129	3.41	11
130	2.39	113	130	2.35	190	130	2.38	149
131	3.58	3	131	3.33	26	131	3.50	7
132	2.23	144	132	2.30	197	132	2.25	171
133	2.57	78	133	2.30	197	133	2.48	113
134	2.52	84	134	3.00	71	134	2.67	75
135	2.60	71	135	2.90	90	135	2.70	66
136	1.91	204	136	3.18	44	136	2.30	160
137	2.30	135	137	3.38	22	137	2.63	82
138	1.78	225	138	2.53	158	138	2.03	210
139	1.95	198	139	2.78	110	139	2.19	184
140	1.97	194	140	2.78	110	140	2.18	186
141	1.66	243	141	2.53	158	141	1.93	224
142	1.85	213	142	3.18	44	142	2.27	167
143	2.23	144	143	2.85	97	143	2.42	137
144	2.64	66	144	3.28	32	144	2.84	48
145	1.82	221	145	2.98	78	145	2.18	186
146	1.60	250	146	2.85	97	146	1.99	211
147	1.84	216	147	3.00	71	147	2.20	180
148	2.19	153	148	2.70	126	148	2.35	152
149	1.21	269	149	2.10	224	149	1.53	260
150	2.13	170	150	2.23	213	150	2.16	189
151	1.74	232	151	2.18	218	151	1.88	230
152	2.24	142	152	2.40	180	152	2.29	166
153	3.08	23	153	3.25	35	153	3.13	19
154	2.35	120	154	3.15	49	154	2.60	88
155	2.36	115	155	2.65	141	155	2.45	123
156	2.85	40	156	3.10	56	156	2.93	35

APPENDIX B.4 - (CONT'D)

TRANSIT OPERATORS			GOVERNMENT AGENCIES			COMBINED		
PROJECT NUMBER	AVERAGE SCORE	OVERALL RANKING	PROJECT NUMBER	AVERAGE SCORE	OVERALL RANKING	PROJECT NUMBER	AVERAGE SCORE	OVERALL RANKING
157	2.73	55	157	3.48	15	157	2.96	32
158	2.17	158	158	2.80	105	158	2.39	147
159	1.52	258	159	2.05	226	159	1.69	249
160	2.63	69	160	2.78	110	160	2.68	73
161	2.41	111	161	2.88	94	161	2.55	101
162	2.82	45	162	3.28	32	162	2.96	32
163	2.32	127	163	3.23	37	163	2.60	88
164	1.61	249	164	2.73	121	164	1.96	218
165	2.70	59	165	2.30	197	165	2.58	96
166	2.05	182	166	1.85	243	166	1.98	212
167	2.32	127	167	2.30	197	167	2.31	158
168	2.20	151	168	3.03	65	168	2.48	113
169	2.02	188	169	3.03	65	169	2.34	154
170	2.16	160	170	2.33	193	170	2.22	176
171	2.17	158	171	3.10	56	171	2.46	119
172	2.91	37	172	2.90	90	172	2.91	39
173	2.86	38	173	3.50	12	173	3.06	25
174	1.80	223	174	2.35	190	174	1.97	216
175	2.72	57	175	3.05	63	175	2.82	51
176	1.83	220	176	2.58	152	176	2.06	207
177	1.06	271	177	2.15	222	177	1.43	265
178	0.95	274	178	2.05	226	178	1.32	271
179	2.16	160	179	2.93	88	179	2.40	145
180	1.40	265	180	1.48	264	180	1.43	265
181	1.73	237	181	1.53	261	181	1.66	253
182	1.74	232	182	1.73	248	182	1.73	247
183	1.63	248	183	1.58	257	183	1.61	256
184	1.48	262	184	1.63	254	184	1.53	260
185	1.45	263	185	1.43	265	185	1.44	264
186	2.20	151	186	3.23	37	186	2.54	104
187	2.08	177	187	3.08	62	187	2.41	140
188	2.31	129	188	2.78	110	188	2.47	117
189	2.31	129	189	2.75	116	189	2.46	119
190	1.90	205	190	2.40	180	190	2.07	205
191	1.49	261	191	1.30	272	191	1.43	265
192	1.77	227	192	2.40	180	192	1.97	216
193	1.59	253	193	2.53	158	193	1.88	230
194	1.70	241	194	1.53	261	194	1.65	255
195	2.05	182	195	1.68	253	195	1.93	224
196	1.20	270	196	1.35	269	196	1.25	275
197	1.40	265	197	2.03	230	197	1.61	256
198	2.06	178	198	2.33	193	198	2.14	193
199	1.51	259	199	1.10	275	199	1.38	268
200	1.44	264	200	0.98	276	200	1.30	273
201	2.18	156	201	2.55	155	201	2.30	160
202	1.88	209	202	1.70	252	202	1.82	239
203	2.38	114	203	2.55	155	203	2.43	131
204	1.64	244	204	1.13	274	204	1.47	263
205	1.74	232	205	1.33	270	205	1.60	258
206	2.11	173	206	1.38	267	206	1.88	230
207	2.68	62	207	2.68	134	207	2.68	73
208	1.92	202	208	1.63	254	208	1.83	236

APPENDIX B.4 - (CONT'D)

TRANSIT OPERATORS			GOVERNMENT AGENCIES			COMBINED		
PROJECT NUMBER	AVERAGE SCORE	OVERALL RANKING	PROJECT NUMBER	AVERAGE SCORE	OVERALL RANKING	PROJECT NUMBER	AVERAGE SCORE	OVERALL RANKING
209	1.86	212	209	1.73	248	209	1.82	239
210	1.73	237	210	1.50	263	210	1.66	253
211	1.64	244	211	2.45	168	211	1.91	228
212	2.00	192	212	2.90	90	212	2.30	160
213	2.69	60	213	2.05	226	213	2.48	113
214	3.10	19	214	3.45	18	214	3.21	15
215	2.34	123	215	2.85	97	215	2.50	112
216	2.61	70	216	2.03	230	216	2.43	131
217	2.58	76	217	2.40	180	217	2.52	109
218	2.83	43	218	2.48	166	218	2.71	65
219	2.13	170	219	2.28	204	219	2.18	186
220	1.75	228	220	2.00	236	220	1.83	236
221	1.75	228	221	1.15	273	221	1.55	259
222	1.96	195	222	2.70	126	222	2.21	177
223	2.48	98	223	2.65	141	223	2.53	107
224	2.42	108	224	2.45	168	224	2.43	131
225	2.98	30	225	2.69	134	225	2.88	41
226	2.84	42	226	2.58	152	226	2.75	59
227	1.85	213	227	1.73	248	227	1.81	242
228	2.31	129	228	2.45	168	228	2.35	152
229	2.15	165	229	2.68	134	229	2.31	158
230	2.05	182	230	2.55	155	230	2.20	180
231	2.27	139	231	2.80	105	231	2.44	126
232	2.50	91	232	2.78	110	232	2.59	93
233	1.94	200	233	2.38	186	233	2.08	202
234	1.79	224	234	2.23	213	234	1.93	224
235	2.28	138	235	2.48	166	235	2.34	154
236	2.45	102	236	2.43	174	236	2.44	126
237	1.84	216	237	2.25	209	237	1.98	212
238	2.05	182	238	2.25	209	238	2.12	196
239	1.99	193	239	2.45	168	239	2.14	193
240	1.90	205	240	2.03	230	240	1.94	222
241	1.90	205	241	1.58	257	241	1.80	243
242	1.58	255	242	2.28	204	242	1.80	243
243	2.34	123	243	2.53	158	243	2.40	145
244	1.75	228	244	2.70	126	244	2.07	205
245	2.36	115	245	2.63	145	245	2.61	86
246	1.01	273	246	2.03	230	246	1.38	268
247	2.23	144	247	2.28	204	247	2.24	173
248	2.06	178	248	2.13	223	248	2.08	202
249	2.02	188	249	2.43	174	249	2.15	192
250	2.55	79	250	2.03	230	250	2.38	149
251	2.23	144	251	1.95	242	251	2.14	193
252	2.31	129	252	2.80	105	252	2.46	119
253	2.95	32	253	3.03	65	253	2.98	30
254	2.68	62	254	2.75	116	254	2.70	66
255	3.30	12	255	3.03	65	255	3.21	15
256	3.09	21	256	3.23	37	256	3.13	19
257	3.11	18	257	2.20	216	257	2.83	50
258	2.19	153	258	2.23	213	258	2.20	180
259	1.92	202	259	2.43	174	259	2.08	202
260	3.13	17	260	3.40	19	260	3.21	15

APPENDIX B.4 - (CONT'D)

TRANSIT OPERATORS			GOVERNMENT AGENCIES			COMBINED		
PROJECT NUMBER	AVERAGE SCORE	OVERALL RANKING	PROJECT NUMBER	AVERAGE SCORE	OVERALL RANKING	PROJECT NUMBER	AVERAGE SCORE	OVERALL RANKING
261	2.58	76	261	2.20	216	261	2.46	119
262	2.15	165	262	2.00	236	262	2.10	200
263	2.02	188	263	2.78	110	263	2.26	169
264	2.27	139	264	2.75	116	264	2.42	137
265	2.01	191	265	2.63	145	265	2.20	180
266	2.10	174	266	1.55	260	266	1.93	224
267	2.15	165	267	2.18	218	267	2.16	189
268	1.93	201	268	1.98	239	268	1.95	219
269	2.42	108	269	2.45	168	269	2.43	131
270	2.44	103	270	2.80	105	270	2.55	101
271	1.82	221	271	1.60	256	271	1.75	246
272	2.47	100	272	2.90	90	272	2.60	88
273	2.92	35	273	2.50	164	273	2.79	55
274	2.24	142	274	2.98	78	274	2.47	117
275	3.52	5	275	3.33	26	275	3.46	9
276	2.93	34	276	2.70	126	276	2.86	44